HISTORY

VOLUME I

# history of the OFFICE OF AEROSPACE RESEARCH

JANUARY-JUNE 1968



OFFICE OF AEROSPACE RESEARCH

OFFICE OF AEROSPACE RESEARCH • UNITED STATES AIR FORCE

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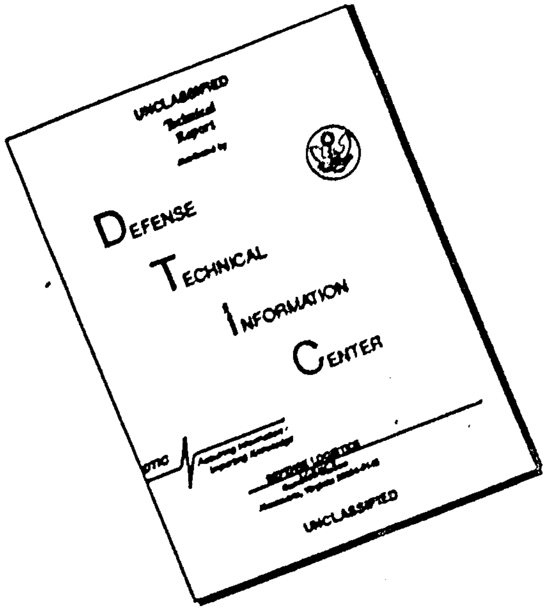


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# HISTORY OF THE
# OFFICE OF AEROSPACE RESEARCH

January - June 1966

Volume I

Historical Division
Office of Information
Office of Aerospace Research
Arlington, Va.
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## FOREWORD

Because science and the administration of science sometimes do not lend themselves conveniently to six-month historical segments, there has been no attempt to give a detailed and comprehensive survey of all the activities of the Office of Aerospace Research (OAR) during this reporting period. Instead, for the period January through June 1966, the OAR Historical Division has concentrated on a survey of administrative highlights of the Headquarters and on specific management aspects of the OAR scientific program and research administration.

In order to cover fully the history of OAR's subordinate units and their scientific programs, the Historical Division will from time to time issue special historical monographs covering the complete administrative history of one of the OAR units or a major scientific program in one of the laboratories.

None of the chapters included in this volume could have been prepared without the cooperation of many members of the OAR staff, who have supplied documentation and answered questions. Although there is no room to mention everyone by name, their assistance is gratefully acknowledged by the Historical Division.

Robert F. Phillips
Chief, Historical Division
Office of Information
October 1967

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## CHRONOLOGY

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| 25 January 1966 | Dr. Hans J. P. von Ohain, Chief Scientist at the Aerospace Research Laboratories (ARL), received the Goddard Award from the American Institute of Aeronautics and Astronautics (AIAA). The award, named in honor of Dr. Robert H. Goddard, the rocket pioneer, is given to persons who have made a brilliant discovery or a series of outstanding contributions over a period of time in the engineering science of propulsion or energy conversion. |
| 25-26 February 1966 | The Scientific Advisory Group (SAG) devoted its meeting, held in Los Angeles, Calif., to the OAR role in limited war, with the emphasis, of course, on Southeast Asia. |
| 30 March 1966 | For the first time a single booster (Atlas) was used to place two separate scientific satellites (OV1-4 and OV1-5) into two different orbits. The two satellites rode into space in the nose cone of the Atlas, but each carried its own solid-fuel rocket for the second stage of its journey into orbit. |
| 5 April 1966 | First Office of Aerospace Research (OAR) Research Applications Conference held in Washington, D. C. The conference was held to acquaint senior government officials in Washington, D. C. area with research and development contributions made by OAR to the Air Force and other Department of Defense (DOD) agencies. |
| 5-7 April 1966 | The Scientific Advisory Board (SAB), holding its meeting at the U.S. Air Force Academy, Colorado, also concentrated on Southeast Asia limited war problems and OAR's role in that field. |
| 18 April 1966 | The National Academy of Sciences and the National Research Council named fifteen outstanding young scientists to participate during the next academic year in the Postdoctoral Research Program supported by the Air Force Office of Scientific Research (AFOSR). This program, now in its sixth year, provides young investigators of superior ability with special opportunites for advanced study and fundamental research in areas of the natural and applied sciences which are of particular importance to the Air Force as sources of future technology. |

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| 22 April 1966 | The OV3-1 satellite was launched from the Western Test Range, by a Scout booster, into a near-perfect orbit. The satellite measured the energetic charged particle environment in the near-earth space. |
| 15 May 1966 | With the launching of the National Aeronautics and Space Administration's (NASA) NIMBUS C from Vandenberg AFB, the Air Force Cambridge Research Laboratories (AFCRL) began evaluating the new experimental infrared system aboard NASA's newest weather satellite. The NIMBUS C will take high resolution infrared nighttime pictures from its 600-mile circular orbit. AFCRL was one of seven key stations (from among 150) chosen by NASA and the Air Force for this evaluation program. Its Meteorology Laboratory's Automatic Picture Taking (APT) equipment has been modified to accommodate transmissions of infrared photographs to be transmitted by NIMBUS C. |
| 20 May 1966 | Headquarters Office of Aerospace Research and the Air Force Office of Scientific Research began moving from Washington, D. C. to their new location in Arlington, Virginia. The move took place over a nine-day period. |
| 1 June 1966 | Lt Col John J. Apple, formerly with Hq OAR's DCS/Plans & Programs, assumed command of OAR's Patrick Field Office upon the retirement of Lt Col Augustus F. Williams, Jr. |
| 6 June 1966 | AFCRL established a new West Coast office at the Space Systems Division, El Segundo, Calif. The office has the organizational status of a laboratory. The new office will provide consultation service to the Space Systems Division and Ballistic Systems Division, and for the deputy commander of the Manned Orbiting Laboratory (MOL) program. |
| 9 June 1966 | Colonel Robert E. Fontana, ARL Commander, received the Legion of Merit for his significant accomplishments at ARL. |
| 10 June 1966 | The OV3-4 satellite was successfully orbited, by a Scout booster, from Wallops Island, Va. The experiment, provided by the Bioastronautics group of the Air Force Weapons Laboratory, explored spectral and depth dose measurements in the inner Van Allen radiation belt. |

15-22 June 1966 — The Eleventh Science Seminar of the Air Force Office of Scientific Research was held in Albuquerque, New Mexico. "Challenge and Promise: Emerging Concepts in Basic Research" was the theme of the seminar. Although AFOSR-supported, it was held with the cooperation of the University of New Mexico and the Air Force Systems Command's (AFSC) Special Weapons Center at Kirtland AFB, New Mexico. The seminar was dedicated to the memory of Dr. W. Randolph Lovelace II, late president of the Lovelace Foundation for Medical Education and Research, who died in the crash of a private airplane in December 1965.

16 June 1966 — Colonel Paul G. Atkinson, Jr., Deputy Commander, ARL, replaced Colonel Robert E. Fontana as ARL Commander, upon the latter's assignment to the Air Force Institute of Technology (AFIT) as chief of the Electrical Engineering Department.

20 June 1966 — The Office of Aerospace Research was awarded the Air Force Outstanding Unit Award for exceptionally meritorious service from 1 April 1964 through 31 March 1966. The personnel of OAR were cited for conducting a "vigorous and dynamic research program . . . which resulted in a vastly improved research capability to meet the technological requirements of the Air Force" in the years ahead.

22 June 1966 — AFCRL launched a 26-million-cubic-foot-balloon, twice the size of any previous balloon, from Holloman AFB, New Mexico. The balloon system at the time of launch stood 815 feet above the ground (Empire State Building - 1250 feet), and was designed to test NASA's Voyager Mars landing capsule.

23 June 1966 — Captain James T. Neal of AFCRL's Terrestrial Sciences Laboratory and Major Robert M. Detweiler of ARL's Solid State Physics Research Laboratory, were each presented one of the Air Force's five Research and Development (R&D awards by Air Force Chief of Staff John P. McConnell. Captain Neal received the award for his research on dry lake beds suitable for aircraft emergency landings. Major Detweiler received his award for conducting research which added substantially to the present knowledge of the defect structure of semiconductors and for experimental techniques that have been universally recognized.

# MISSION, ORGANIZATION, AND RESOURCES

Although there were no major changes in either the mission or in the human and material resources of the Office of Aerospace Research (OAR) during January through June 1966, a new statement of OAR's overall mission, with some modifications, was issued. The Command still continued to exercise management responsibility for the Air Force research program and for a few areas of Air Force exploratory development. OAR, as in previous reporting periods, accounted for only a fraction of one percent of the total Air Force manpower and fund allocations.

## Mission and Organization

The previous overall mission statement of OAR, that of 13 August 1963, spelled out OAR's mission in the following terms:[1]

> (1) To conduct and support research in those areas which offer the greatest potential for providing new knowledge essential to the continued superiority of the Air Force operational capability.
>
> (2) To conduct and support specifically assigned exploratory development efforts.

In the new mission statement, OAR was:

> (1) To conduct and support research which is relevant to Air Force interests and in those areas where new knowledge is essential to the continued superiority of the Air Force operational capability.
>
> (2) To conduct and support specifically assigned exploratory development efforts.

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[1] AFR 23-18, 5 April 1966.

(3) To insure the effective dissemination of research results to those responsible for the development of improved aerospace technology, weapons, equipment and operations.[2]

While it could not be classified as an organizational change, OAR assumed additional responsibilities, in January 1966, when the National Sonic Boom Evaluation Office (NSBEO) came under its jurisdiction as a tenant unit. The Office was set up under the White House Office of Science and Technology to organize and monitor an overall program of applied research and development, including field surveys, laboratory investigations, and community overflights, that would provide the basis for predictions of public reactions to sonic booms generated by future commercial supersonic transport aircraft. Actually, the Secretary of the Air Force designated OAR as the agency responsible for program technical guidance of the sonic boom program in late 1965. Then, in December 1965, the USAF Director of Development, in a letter to Brig. Gen. Ernest A. Pinson, OAR Commander, spelled out OAR's areas of responsibilities.[3] The costs entailed in OAR's contribution to the sonic boom program were to be paid by the Federal Aviation Agency (FAA). OAR was expected to contribute as follows:

a. OAR should clarify and state requirements for research and studies.

b. OAR should assist in the evaluation of proposals for the performance of investigations, preparation of reports, and the acquisition of equipment.

c. OAR would administer funds provided by FAA for support of the program. Funds allocation would be coordinated through the program executive management.

d. OAR would procure and support proposals that had been received, evaluated, and approved for purchase.

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[2] AFR 23-18, 13 August 1963.

[3] Ltr, Brig Gen Andrew J. Evans, Jr., Director of Development, DCS/R&D to Commander, OAR, 21 Dec 65, subj: "OAR Participation in the National Program for the Evaluation of Public Reaction to Sonic Boom."

e. OAR should supply or nominate project scientists and engineers to monitor research grants or contracts.

f. OAR would secure and coordinate transmittal of reports based on grant or contract efforts or internally produced communications regarding the status of the program.

g. OAR would provide advice and consultation on scientific and technical problems and would assist in the acquisition of expert assistance and opinions with regard to public information claims and insurance.

h. OAR would monitor and provide fund authorization for travel of personnel engaged in business relating to the national sonic boom program. Personnel selected for travel will be coordinated through USAF's Director of Development.

i. OAR would maintain records that would account for all funds expended and the use made of resources obligated to this task.

j. OAR would provide those resources necessary to accomplish those functions within the constraints imposed by limitations of time, personnel, and funds.[4]

To assist OAR in performing these functions, USAF R&D requested that the Air Force Office of Manpower and Organization (AFOMO) raise the man-year ceiling of OAR for the duration of the sonic boom task. As an initial increment it was recommended that the manpower ceiling be augmented for the period of 1 January 1966 to 31 December 1966. These recommendations were carried out by AFOMO. In addition, the USAF Director of Procurement recommended an extension of the man-year allocation, if necessary, when it was possible to forecast the duration of the task.[5]

For better coordination of effort, the sonic boom program office was moved from the Pentagon to Tempo D, the building in which OAR was located.

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[4] Ibid.

[5] Ibid.

Col. Charles R. Foster, Deputy Executive Manager of the National Sonic Boom Evaluation Program, headed the office, although Brig. Gen. Edward B. Giller, DCS/Air Force Director of Science and Technology (AFRST) was the moving force that got the program off to a good start.

Dr. Charles E. Hutchinson, Chief of the AFOSR Directorate of Life Sciences' Behavioral Sciences Division, was nominated by Dr. Alexander H. Flax, Assistant Secretary of the Air Force (R&D), as the person in the Air Force responsible for the technical aspects of the public response program. This assignment was confirmed by the Secretary of the Air Force.

The outstanding event at Headquarters Office of Aerospace Research during this reporting period was the award of the Air Force Outstanding Unit Award to OAR on 20 June. The citation accompanying the award read:

> "The Office of Aerospace Research distinguished itself by exceptionally meritorious service in support of military operations, from 1 April 1964 to 31 March 1966. During this period, the personnel of the Office of Aerospace Research conducted a vigorous and dynamic program which resulted in a vastly improved research capability to meet the technological requirements of the Air Force in the years ahead. The distinctive accomplishments of the members of the Office of Aerospace Research have contributed significantly to the defense of the United States, and reflect great credit upon themselves and the United States Air Force."

These few cryptic lines, however, do not begin to tell the whole story of OAR's significant management and research accomplishments during the period covered by the citation. Some of the management accomplishments included:

1. <u>Exceeding its FY 1965 cost reduction goal by 1700 percent</u>.

Combining the qualities of imaginative research and sound management, OAR accomplished cost reduction in almost every phase of its activity. As has been pointed out by the Chief of Staff, USAF, "This achievement is all the more impressive because the OAR mission and organization do not readily lend themselves to the formal reporting of cost reduction."

2. Receiving a highly favorable report from the USAF Inspector General following a management inspection of OAR.

As a result of this report the Chief of Staff, USAF, stated that management of OAR was "excellent" and that he was "especially" gratified to note that OAR has highly-motivated personnel who are using sound management techniques to assure acquisition of scientific knowledge so vital to future USAF and national needs.

3. Successfully maintaining and operating the Churchill Research Range.

When the Churchill Research Range was turned over to the government of Canada on 1 January 1966, OAR successfully completed its duties as USAF manager and operator of one of the most unusual and successful rocket facilities in the world. By providing continuously high quality, rapid, but economical, logistical support; by selectively staffing the facility with expert scientific support personnel and managers; and by employing a positive approach to every problem presented, OAR carried out its responsibility as Executive Agent for the DOD in an outstanding manner.

4. Pioneering in the use of automated Management and Scientific Information System (MASIS).

OAR's forward thinking approach to the problems of research management led to the establishment of the first MASIS in the U.S. Air Force. Recently automatic indexing capabilities have been added to make the system an even more effective decision-making tool for research managers.

5. Pioneering in the Selective Dissemination of Information (SDI) Program.

Recognizing early, even before inception of the Air Force's Scientific and Technical Information (STINFO) Program, that the rapid communication of the results of research to those who can put the knowledge to best use was a problem of management, OAR pioneered in improving the communication process. Its latest achievement has been an experimental program for the selective dissemination of research results based on the

scientific interests (validated profiles) of approximately 3,000 people throughout the Air Force.

6. Reducing the time gap between discovery and application of new knowledge through coupling.

Further efforts by OAR to improve the communication process have fallen under the term "coupling," the transfer of research results to users and the feedback from users. Recent OAR policy decisions have created an environment in which scientists, as individuals and as members of groups, are motivated to seek a balance between doing original research and coupling the results of this research to Air Force objectives and technological needs. OAR briefing teams and individual scientists now present latest scientific findings to potential Air Force users, discuss present technological problems, anticipate future needs, and seek a mutual effort to reduce the time between discovery of new knowledge and its applications. Also, OAR scientists serve on some 45 DOD scientific panels, advisory boards, and committees set up to review the state-of-the-art in differing research fields and to make recommendations for applications on future research programs.

7. Using barter funds to obtain research overseas without contributing to the balance of payments problem.

Recently, OAR, through its European Office of Aerospace Research, initiated a procedure for obtaining research overseas through the use of barter funds. This procedure enables the Air Force to continue to obtain valuable research from outstanding foreign scientists without contributing to the gold-flow problem. OAR managers pioneered this procedure and had to overcome seemingly impossible obstacles before they could prove it was a practical, workable solution. Careful management has enabled OAR to obtain high-quality research at a comparatively small cost from foreign scientists. By working out cost-sharing arrangements with European scientists, OAR pays less than 50 percent of the direct costs for doing this research which is of vital interest to the Air Force. For example, in FY 1965, the OAR share of the cost of doing research in Europe was 44 percent and $8.2 million worth of research cost OAR $3.7 million.

8. Insuring relevancy and applications of research.

Through careful planning, management, and supervision, OAR has insured that its research is relevant and responsive and has direct applications to the needs of the Air Force in the immediate and distant future. A recent example of relevancy was the first OAR Research Applications Conference, held on 5 April 1966, and attended by key research and development personnel from the Department of Defense and all military services. The conference demonstrated, through specific examples, the many ways OAR basic research results can be applied to the solution of DOD technical problems.

9. Managing the joint OAR-AFSC Aerospace Research Support Program (ARSP).

OAR provides management and support for the design, construction, procurement, and instrumenting of research satellites, rocket boosters, and other spacecraft hardware for all Air Force laboratories conducting space research. Its careful management of resources and funds in this costly area of research has enabled our scientists to obtain extremely valuable data at the lowest possible cost.

10. Supporting space research with balloons.

Recognizing that balloons offer an inexpensive method for obtaining much of the needed research in the space and near-space environment, OAR has pioneered many innovations in ballooning during the past two years. In addition to launching more than 100 balloons in support of a wide range of research and development activities, OAR has perfected balloon recovery techniques which have resulted in major savings. Two ingenious techniques for recovering balloons after flight have been successfully tested--the tandem launch and recovery system, and the parachute technique. These tests, in April and May 1965, have been called the most significant balloon experiments of the past decade because they proved for the first time that large research balloons can be recovered and reused. OAR has also eliminated several costly steps from balloon fabrication, making it possible to manufacture a lighter balloon and put the most strength

at those points where the greatest stress occurs. Use of OAR's balloon material fabrication technique has enabled the manufacturer to achieve an optimum strength-to-weight ratio, resulting in balloons with heavy payloads reaching extreme altitudes.

OAR has also distinguished itself through responsiveness to the requirements of the Air Force and by the quality and timeliness of its scientific output. Among the most outstanding research achievements of this unique organization were the following:

1. New Particle Separator

Research in energy conversion into fluid dynamic processes by OAR scientists has led to new concepts for the separation of solid and liquid particles from air. This new device sets up a vortex flow in such a manner that the air is not allowed to touch the sides of the chamber. Solid and liquid particles, on the other hand, are thrown out of the vortex and into a container and only pure air emerges from the other end. There are many long-range classified applications of this concept. It is anticipated that the device may well serve as a dust separator in front of the intakes of certain jet engines, helicopter engines, and ground vehicle engines. Also, since the air does not touch the sides of the chamber and since extremely high velocities can be attained, this may eventually be the key to the development of more advanced propulsion systems. In the case of nuclear systems, the device would serve to catch air-contaminating exhaust particles in such a manner that they could be stored and released in space where they would be harmless.

2. Contrail Suppression

For many years the Air Force has been plagued with what to do about contrails, the visible trail that forms behind high flying aircraft. They provide an easy guide for antiaircraft fire or intercepting aircraft, and further enable enemy units to distinguish visually between multi-engine bombers and missiles. After five years of extensive research, OAR has developed two methods for eliminating contrails. One is to use fuel that

produces less water in its exhaust and thus less condensation results. The other is to use a nucleating agent that causes the water to condense into particles too small to reflect light. It was found that the second method was preferable for missiles. Contrail suppression by use of nucleating agents has been effectively demonstrated in B-47 and B-52 bombers. Within the past two years OAR has designed, developed, and installed operational equipment for contrail suppression in a number of operational aircraft.

3. Supersonic Combustion

Present supersonic aircraft pay a great weight penalty because intake air must be slowed to subsonic speeds before entering the reaction chamber. It is natural, therefore, that the Air Force should be conducting research into the problems of supersonic combustion. One of the concepts, suggested by scientists of OAR, involves compressors with blunt trailing edge compressor blades. This new type of blading may well extend the capability of turbojet engines. It is expected that more powerful engines with fewer compressor stages will be possible and the saving of weight will greatly increase operating efficiency from subsonic through supersonic flight regimes. Such an engine can be started using conventional starting techniques and will operate with supersonic ramjet efficiency at hypersonic speeds; thus, the Air Force may eventually be able to employ turbojet engines to propel aircraft at speeds as high as Mach 4, while carrying larger payloads over greater distances.

4. Optimum Reentry Vehicles

Man has been launched into space and successfully returned in the Mercury and Gemini-type drag capsules. These blunt shapes possess high aerodynamic drag. A second generation reentry vehicle is one which will possess low drag and high lift in order to permit the astronaut to maneuver more effectively to some landing site. In order to gain some understanding of the problems involved in developing this class of vehicle, OAR scientists undertook a study of the optimum vehicle geometry that would maximize the lift-to-drag ratio at high speeds. Using electronic computer techniques, a

configuration was determined which provides maximum lift-to-drag ratio and encloses a prescribed volume with the minimum area (and thus minimizes structural weight). The optimum configuration was found to be a blunted cone with flat top and bottom surfaces and a hemispherical base. Such a spacecraft body possesses higher lift-to-drag ratios and is far superior to other lifting configurations previously studied. Examination of the configuration shows that development of this vehicle is feasible in the foreseeable future.

5. Rare Earth Metals Yield to Gas Chromatography

One of the most pervasive problems in chemistry and biochemistry is that of analyzing or separating complex mixtures of matter. Perhaps the newest and most versatile analytical technique devised to attack this problem is gas chromatography. It has become an indispensable method for separating volatile organic compounds, but its application to inorganic compounds such as in metals analysis has been much slower in coming about. In this latter area, OAR chemists have made pioneering contributions. The fundamental problem has been to convert the metals into volatile, stable compounds; the key to the solution was the discovery that metallo-organic complexes of various B-diketones, which are a class of metal chelate compounds having the requisite properties. As a result, it now appears possible in principle to separate virtually any mixture of metals by gas chromatography, and many difficult separations have already been achieved experimentally. The remarkable volatility of these compounds gives rise to other metals such as copper, rhodium, or nickel, can be achieved by passing a carrier gas containing the wanted metal chelate over a base heated a few degrees above the decomposition temperature of the chelate. Further studies of the chemical processes that occur to determine the feasibility of adapting the technique to practical vapor plating problems are in progress. Recently, increasing attention has been focused on the rare earth metals. Since it is difficult to separate these elements and get pure samples, they are rare in terms of both knowledge and cost. The elements and their compounds are very similar chemically, and always occur together in nature. Their chemical similarity has necessitated the use of costly and tedious separation procedures based on such techniques as fractional

crystallization and ion exchange. Despite their high cost, they have found a limited field of use in such diverse applications as lasers, phosphors, catalysts, and materials of construction . . the nuclear field. To provide less costly separation, efforts were begun to find volatile complexes that would be amenable to gas chromatographic separation. Only recently, the first separation of rare earth chelates by gas chromatography was achieved by OAR, thus making possible the prospect of greatly increased supplies of these rare earths.

6. Nuclear Tests Data

Since 1964, OAR has fully analyzed nuclear tests data taken by Air Force scientists during the 1962 tests in the Pacific. As a result of these analyses, the Air Force now has definitive data on the effects of atmospheric nuclear detonation over a range of altitudes, and is provided with quantitative data on operational frequencies for communications and optimum atmospheric windows for surveillance and detection under nuclear warfare conditions.

7. Emergency Operational Bases

Through an extensive geology study, OAR has identified, largely for SAC, all dry lake beds in the western United States that may serve for emergency landing areas or for alternate operational bases.

8. Infrared Detectors

Through its large upper atmosphere and optics research program, coupled closely with research in new infrared instrumentation, OAR has identified clear atmospheric windows and has developed infrared detectors in the wavelength regions of these clear atmospheric windows. Such detectors can be carried aboard spacecraft, aircraft, or balloons.

9. Solar Proton Shower Prediction

OAR was one of the first to recognize the hazard of high-energy solar proton showers to electronic instruments and to personnel in spacecraft. This led to the development of techniques for predicting periods when there would be an absence of this ionizing radiation. OAR continues

to be the leading research agency in this field and has greatly refined and extended its prediction techniques for predicting periods when there would be an absence of this ionizing radiation.

10. Standard Atmosphere

A book of standard reference tables on temperatures, densities, pressures, humidities, and so forth, at various altitude strata out to 700 km was prepared under the guidance of OAR. Much of the data for this compilation resulted from hundreds of rocket and satellite experiments conducted by OAR over the past several years. Such reference tables are essential to the design and launch of rockets, missiles, and satellites.

11. Boron Fiber Program

In October 1965, OAR scientists were asked to participate in a meeting at the Air Force Materials Laboratory to discuss problems in connection with difficulties in producing boron filaments having uniform strength properties, a part of a comprehensive program leading to the development of improved composite materials for specific structure applications in aerospace vehicles. It was generally concluded that detailed knowledge of the microstructure, the extent and kind of crystallinity present and the magnitude of internal strains was required in order to understand what processing variables were responsible for the lack of uniform properties. OAR scientists started to work on these problems and completed the investigation in less than five months. The study included an investigation of the strength in tension and bending, maximum elastic strain in bending modulus of elasticity, fracture mode, x-ray examination of the structure at room temperature and during and after treatment in vacuum at 1000$^{o}$ C. and 1200$^{o}$ C., and an electron diffraction study of the structure. This series of related experiments determined several basic parameters of the material. However, the most significant result was a reasonably clear-cut characterization of the "amorphous" structure. They found that the filaments are composed of crystalline Betarhombohedral boron built up in layers which are preferentially oriented. Also, as produced, the filaments retain considerable internal strain which interferes with

identification by the usual x-ray techniques and that heating to $1200^{\circ}$ C. is necessary to remove the strains.

12. Moving Striations in a Plasma Column

OAR has been studying certain phenomena known as atriations or ionization waves observed in glow discharge tubes. As a result of this program, predictions as to the cause for these striations, the thresholds for their occurrence and some means of avoiding them have been made. Knowledge of these phenomena is important because when the striations occur in gas lasers they can cause modulation in the output with detrimental effects on power output; i.e., they constitute an undesirable instability. The results and implications were used in a joint program with personnel of the Electronic Technology Laboratory (ETL) of the Air Force Avionics Laboratory (AFAL) in research on the instabilities in gas lasers being built at ETL. This research resulted in a joint publication in the Journal of Applied Physics on "Moving Striations in a He-Ne Laser." This research also resulted in a very novel and useful technique for improving the signal-to-noise ratio in plasma diagnostics which has been applied in the detection of weak ion acoustic waves in low pressure plasmas. A joint paper with scientists of the Oak Ridge National Laboratory appeared in the May 1965 Journal of Scientific Instruments.

13. Space Vehicle Photometry

Since 1962 OAR's General Physics Research Laboratory has been engaged in a research program on the optical properties of orbiting space vehicles. These photometric studies of satellites were begun with the fortuitous observation of the brightness fluctuation of a Soviet rocket carrier during image orthicon recording of the satellite in 1960, and the subsequent attempts to establish the necessity of automatic exposure control for the image orthicon to prevent "blooming" of the image. Research has continued on the methods of correlation of the light curves with such factors as geometry of the space vehicle, tumble and spin rates, projections, etc. At present the only known efforts at optical signature collection from satellites are those of OAR and of the Air Force Avionics Laboratory

Cloudcroft, New Mexico installation. OAR now has a unique 24-inch telescope mounted on a 4-axis, hand-controlled satellite tracker. This instrument and the AFAL New Mexico instrument represent the present data collection centers for all USAF agencies. No comparable Soviet effort is known. As a consequence of the success of this program, the Avionics Laboratory has made a formal request for participation by OAR in their technical program. The success in acquiring heretofore unobtainable information on Soviet satellites from this optical data has generated great demands for data collection about spacecraft by other agencies, in addition to AFAL. Examples are a cooperative program with the Foreign Technology Division (FTD) on optical intelligence and assistance on a periodic basis to NORAD on Space Object Identification. Recently, RCA has requested optical data for correlation with their radar data on an Electronic Systems Division (ESD) program in support of System 496 L. Numerous other uses are being made of the results of this research such as timing of flash discharges of geodetic satellites and inference of orientation in space of selected vehicles for NASA. It has been clearly demonstrated that ground-based instruments can resolve targets more than a few feet in size if they are in low orbits and thus provide data on configuration, orientation, size, and surface finish. In the same way that long-focus, ground-based telescopes can image appropriate space vehicles at distances of 100 to 500 miles and provide detailed property data, the collection of data on the optical brightness of space vehicles and especially the brightness fluctuations as a function of time, can yield information by indirect methods on these same characteristics. While the results are less accurate, these data can be obtained at much greater slant ranges than those which allow the direct imaging of the target through the atmosphere. Such optical methods appear nearly as good as radar methods, cost only 1/100 as much, and are applicable to targets out to 20,000 miles with the existing OAR equipment.

In addition to providing outstanding research through its own in-house laboratories and through its grants and contracts programs, OAR served the scientific and technological needs of the U.S. Air Force by serving as a window to new scientific knowledge discovered by members of the world scientific

community; it acted in a consultant and advisory capacity to Air Force development and system organization on problems, evaluations, and studies relating to current and future Air Force capabilities; and it strengthened the Air Force scientific and technical community through its professional development of civilian and military scientific personnel, through its contributions to the general scientific environment in the Air Force R&D community, and through its impressive growth in stature and competence as a research organization.

Another highlight of January-June 1966 was the location of Hq OAR and AFOSR in a permanent "home." After years of promises, broken promises, and frustration, the long anticipated move was made in May.

Several interim locations had been considered, in 1964 and 1965, with plans to move into Federal Office Building (FOB) No. 5 when it was completed in 1967. An interim move was necessary because Temporary Building "D," the most recent "home" of OAR, was scheduled for demolition prior to the completion of FOB #5. Finally, in November 1965, the General Services Administration (GSA) made tentative arrangements for occupancy of the Architect Building at 1400 Wilson Boulevard in the Rosalyn section of Arlington, Virginia. These arrangements were subject to the approval, of course, of OAR and DOD. OAR was a bit hesitant about accepting the building since it was difficult to evaluate it in its unfinished condition. Rather than lose still another building—which actually almost happened again—Hq OAR and AFOSR decided to accept the offered building. The acceptance was communicated to the Office of the Assistant Secretary of Defense (OASD) by the Chief of Staff, USAF. The OASD, in turn, informed Headquarters USAF that the GSA offer was a firm commitment "insofar as any governmental transaction of this type can be considered a firm commitment." And so, OAR had a new "home," although the unfinished condition of the Architect Building and OASD's rather nebulous statement regarding the dependability of firm commitments, made for a feeling of uneasiness on the part of the OAR staff.

Selection of the Architect Building, however, meant that the die was cast and that the rest of the accomplishment of finding and occupying a

new home for OAR would lie in two major areas: careful planning of every detail of the move and the ability to react instantly, decisively, and with a high degree of judgment, to unforeseen problems that might arise. As had been the experience of almost every governmental agency that ever made a physical move, the unexpected could be expected. This was especially true in a building not yet finished and to which certain OAR requirements in facilities and appurtenances were to be added at the discretion of the Office, but in agreement with the contractor, the GSA, and OSD. It was to the distinct advantage of the entire workforce, in whatever position, to foresee difficulties, if possible, and to correct them with expedience if (and as) they did occur.

One of the foremost duties was to prepare the layouts for the office space that had been agreed upon at approximately 60,000 feet. A target date of 1 January 1966 was imposed on OAR by higher authority, but since experience had taught OAR representatives that 30 to 45 days would be the minimum time needed, this was considered unrealistic and the only assurance that could be given was that the layouts would be prepared as expeditiously as possible. A "beneficial occupancy date" (BOD) of 1 March 1966 was scheduled at this same time.

By 28 January 1966 detailed layout plans were completed by OAR and forwarded to OSD for approval. Minor corrections to these preliminary layouts were made by mid-February and OAR reserved the right to add its own design for special use areas. From this point the layouts were virtually stabilized, but the 1 March moving date (for the first day) was pushed back to 1 May, then 13 May, and finally, to 20 May.

During March and April, countless meetings were held concerning layout, moving schedules, packing, etc. The building itself was subject to numerous inspections in an effort to determine how rapidly the work was progressing so that a realistic moving schedule could be set up.

At that point all acts had been mainly in the realm of planning, writing, and negotiation, but at long last the physical move began. On 12 May 1966 an official order was cut transferring 61 officers, 1 chief warrant officer, and 49 airmen of OAR and 28 officers of OSR from Tempos "D" and "E" to the

Architect Building. A separate letter for instruction of civilian personnel was distributed.[6] Movement of household goods was excluded, since the order included the statement: "No travel involved." However, in certain hardship cases of both military and civilian personnel, except could be made if approved by the Secretary of the Air Force.

The total strength of officers, airmen, and civilians at this time was about 345, including both OAR and AFOSR. However, the important thing to the mover was not people, but objects in terms of numbers and kind. The largest part of the office equipment inventory was found in the usual chairs, desks, and file cabinets that make up the bulk of office necessities. In the case of the OAR move they were identified in advance by RRM, based on completion of a special inventory. They were as follows:

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| Chairs | 860 |
| Desks | 345 |
| Tables | 200 |
| Typewriters | 223 |
| Adding Machines | 65 |
| File Cabinets | 378 |
| Safes | 77 |
| Davenports | 17 |
| Bookcase (sections) | 600 |
| Blackboards | 65 |
| Office Equipment | 180 |
| Storage Cabinets | 95 |
| Bulletin Boards | 20 |
| Coat Racks | 115 |

[6] OAR S.O. A-21, 11 May 66; Ltr, Col Burl R. Williams to All Civilian Employees of Hq OAR and AFOSR, 17 May 66, subj: Civilian Personnel Transfers to New Duty Station - Arlington, Va.

Officers, airmen, and civilians who had been through numerous previous moves of Government offices and had seen the results of poor planning and operation, were fully convinced that the Tempo "D" and "E" move to the Architect Building could be described as "flawless." Granted, there were a few complaints, which can be attributed to the usual aimless "griping" of individuals who were motivated by the inconvenience of having to move at all. Such reactions were to be expected and did little to detract from the general feeling of the smooth, successful accomplishment of the mission. On the positive side was one typical reaction that represented the overwhelming majority. This came from the office of the Director of Civilian Personnel, where it was reported that the element represented (Training and Placement) was unpacked, furniture and equipment arranged, and conducting "business as usual" within half a day.

Employees were quite faithful in following the instructions that had been so carefully written, including the accomplishment of all preliminary packing, marking, and labeling of furniture and equipment. Most of their moving duties were carried out in advance and they were then granted administrative leave in a time-phased sequence as functions were closed down at Tempos "D" and "E" and physical movements commenced. A pyramidal "telephone notification roster" was drawn up so that employees could be instructed to report to the Architect Building when their equipment had been moved and positioned. Emphasis was placed on continuity of operation, by working at the old location as long as possible and reopening business at the new one as soon as this could be arranged. The exceptions to the "administrative leave" coverage were those persons who were designated as "move coordinators" on the scheduled dates for their office moves. Key officers and airmen from the Directorate of Logistics were on duty or on call at all times during the move, of course, and actually served for long hours seven days a week.

Following the long waiting period, and announcement of the beginning of the move on 12 May, the actual move began on 20 May 1966. One of the planned means of expediting the move was the obtaining of GSA permission to knock a large floor-level hole in the second floor wall of Tempo "D." This

was both expeditious and necessary. The hole was needed for access to a temporary outside elevator, which speeded up the movement of all items and obviated the dependence on the slow, hard method of moving furniture, files, and equipment by means of the building stairways. It was also invaluable in handling large, unwieldy equipment and fragile items that might otherwise be more susceptible to breakage.

Once the word had been given to put the wheels in motion, the responsibility for all movement was that of the contractor, Barrett's Transfer and Storage, Inc., Washington, D. C. On the other hand, necessary liaison continued (especially on the part of the Director of Logistics) and the move coordinators of OAR swung into action as needed for their particular offices. The contractor on most days employed four trucks, which would allow one in transit, one loading at "D" Building, one unloading at the Architect Building, and one on standby. Barrett hired some 35 men to perform the labor.

Five days in advance of the move the DCS/Materiel established a four-man team at the Architect Building, which group carried out preplanned activities and "put out fires," as necessary in case of the unexpected. The team laid out the AFOSR library, placed number plates on the office doors, and erected temporary floor directories. They also assured that two elevators would be in operation for the move and that they were placed on manual override for ease and speed of handling. (An Otis Elevator Company expert was present during the entire move.) Among their many duties, the working supervisory personnel from DCS/Materiel, armed with complete knowledge and documents on the placement of furniture and equipment spotted all of it on a "one item - one position" system that worked to perfection and eliminated any need for more than one move for any given item. In many instances, volunteer (unpaid) laborers, who would ordinarily wear military uniforms or civilian business suits, were seen pushing dollies down the corridors of the new building, which exemplified the existence of a laudable esprit de corps and willingness to participate "above and beyond the call of duty." In short, no amount or kind of effort was spared to assure a "Zero Defects" move.

The "Zero Defects" goal was achieved, insofar as HQ OAR planning and execution was concerned. As in almost any such move, some breakage and damage did occur, but could not be charged against the Zero Defects objective of OAR. Breakage by the contract mover was beyond reach of OAR's control. The mover's supervisory personnel was intentionally kept at "D" Building, while the supervision at the Architect Building was performed by a key nucleus of DCS/Materiel representatives. It may be added that the "defects" that did occur meant inconvenience, but no expense, to HQ OAR, since such incidents were covered by the contractor's insurance. Fortunately, no damage occurred in the "large and delicate objects" category, as they were called in the move contract specifications.

At least a part of the success of the move was attributable to the pre-planned system of stationing a small number of selected OAR officers, airmen, and civilians at each end of the route. They not only performed their duties exceptionally well, but continued at their posts for periods as long as 12 to 14 hours a day in order to be certain that every small detail was carefully supervised, or, when necessary, performed by themselves. With the possible exception of one individual, not one cent was paid or compensatory privilege granted for any of this overtime work.

Before the move began, OAR officers had become realistic almost to the point of cynicism. After the seemingly endless search for a permanent location they had been through, the move schedule was made purposely flexible to hold down personnel confusion and promote the smoothest possible move sequence. This was reflected, for instance, in one part of the move schedule that read:

> . . . Move commences 6 May 1966 (M-Day) and is to be completed by 15 May 1966 (M+9) . . . . It is conceivable that M-Day, the scheduled move 'start' date, could be accelerated or delayed owing to unforeseeable reasons. In this event, RRM will notify each OAR staff office and AFOSR of the revised date subsequent to receipt of official change. Remember, M-Day will always be on a Friday. Once the move has commenced, no further changes are expected to occur which would substantially affect the total number of days allowed to complete the move.[7]

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[7] OAR, Hq OAR/AFOSR Move Plan, "Operation New Home," 21 March 1966, Attachment 1, Move Schedule, with penned amendments. In files of Capt. Robert P. McCoy. Comments on draft MS, RRM staff, 1 Jun 67.

The forecast was correct. M-Day was pushed back to 13 May and then to 20 May, when the first four elements were moved to the 10th floor of the Architect Building. The moves were made in inverse order of the floor numbers as the pre-planned, most logical way, to expedite free movement. The Deputy Chief of Staff for Plans and Programs was one office of four that was split between two days in the schedule and was moved on 21-22 May. Financial Programs (24-25 May), the AFOSR Directorate of Procurement (28-29 May), and the Directorate of Life Sciences (28-29 May) were others that moved on two separate days. One exception to the general pattern was the AFOSR Technical Library, which because of its peculiar nature, had to be handled in a specialized, separate move, and called for its own unique requirements. Unlike the rest of the organization, the Library was moved out of floor sequence and its move and reconstitution began on 18 May, two days before the general move, when it was relocated on the second floor of the Architect Building. All of this was indicative of the special consideration extended to the AFOSR Library and its operation to insure that the best possible conditions were afforded this activity and that it would be reopened as soon as possible.

In a final note on the planning and the move, it is significant to note that OSD selected the Move Plan as a model for other government agencies to follow.

## Meetings, Conferences, and Symposia

On 10-12 January the Air Force Cambridge Research Laboratories and the Advanced Research Projects Agency jointly sponsored a meeting on antenna voltage breakdown. Approximately 30 to 35 representatives from such organizations as the Aerospace Corporation, Stanford Research Institute, Massachusetts Institute of Technology, University of California, Avionics Company, General Electric, McDonnell Aircraft, Ballistic Systems Division, Space Systems Division, and Office of the Assistant Secretary of Defense, attended the classified meeting. The meeting concerned a phenomenon that occurred when missile and satellite antennas were operated at high power in the low densities of the extreme upper atmosphere.

Essentially, they became ineffective radiators. The purpose of the meeting was to review existing research for overcoming breakdown problems and to plan what future research would be needed.

The first Research Applications Conference of the Office of Aerospace Research was held, on 5 April, in Washington, D. C. The conference was held to acquaint senior government officials in the Washington, D. C. area with research and development contributions made by the OAR to the Air Force and other Department of Defense (DOD) agencies. It was particularly intended to demonstrate by specific examples the many ways that OAR basic research results are applied to the solution of DOD technical problems.

Most of the research applications papers presented at this conference were unique in that the solutions to the problems were based upon basic research that was not necessarily oriented toward the problem it ultimately solved. These papers thus emphasized the importance of maintaining a fundamental research effort in the DOD. For new ideas, properly researched, evaluated and reported can greatly reduce the time-to-solution of unanticipated technical problems.

A total of ten research papers were presented at the conference. They included: "A Computational Procedure For Optimum Trajectory and Optimal Control Problems" by Captain Rinaldo F. Vachino of The Frank J. Seiler Research Laboratory (FJSRL); "Boundary Layer Studies - Practical Implications" by E. R. van Driest of North American Aviation, Inc.; "Supersonic Compressor Research" by First Lieutenant John W. Steurer of the Fluid Dynamics Facilities Laboratory, Aerospace Research Laboratories (ARL); "The ARL Inertial Particle Separator for Military Turbine Powered Vehicles" by Lieutenants Roger A. Miller and Robert Poplawski, both from ARL; "Photoelectric Photometry - A New Tool for Satellite Signatures" by Kenneth E. Kissell, ARL; "Precipitation in Ceramics" by Morris E. Fine of the Department of Materials Science, Northwestern University; "Molecular Beams" by A. T. Stair, Jr. of the Optical Physics Laboratory, Air Force Cambridge Research Laboratories (AFCRL); "The Control of Unstable Mechanical Systems" by Captain John F. Schaefer of FJSRL; "The Determination of the Structure of Boron in 'Amorphous' Boron Filaments" by Harry A. Lipsitt of the Metallurgy Research, Metallurgy and Ceramics Research Laboratory, ARL; and

"From Quantized Flux to a Free Precession Nuclear Gyro" by William M. Fairbank, William O. Hamilton, and C. W. F. Everitt of the Department of Physics, Stanford University.

On April 13-14, the Aerospace Research Laboratories (ARL) hosted an international symposium on "Magnetic Wind Tunnel Model Suspension and Balance Systems" in the ARL auditorium. The first day was devoted to technical presentations covering both the theoretical and experimental aspects of the magnetic system, while the second day was taken up with round table discussions of programmed topics. One of the primary purposes of the symposium was to solidify the general thinking regarding optimum design approaches, inherent limitations of the system, and usable ranges of applicability.

The Eleventh Science Seminar of the Air Force Office of Scientific Research (AFOSR) was held from 15-22 June at Albuquerque, New Mexico. "Challenge and Promise: Emerging Concepts in Basic Research" was the theme of the seminar. The AFOSR-supported seminar was held with the cooperation of the University of New Mexico and the Air Force Systems Command's Special Weapons Center at Kirtland Air Force Base, New Mexico. Eleven leading scientists, ten of whom did research under AFOSR support, together with a noted science writer, participated in the event. They spoke on research which seemed to be developing along promising lines.

Participants included Dr. Henry Margenau, Eugene Higgins Professor of Physics and Natural Philosophy, from Yale University, spoke on "The Philosophy of Modern Science"; Dr. Burton L. Henke, Professor of Physics, Pomona College (California), on "Ultrasoft X-Ray Physics, Pure and Applied"; Dr. U. S. von Euler, Professor of Physiology, Karolinska Institute, Stockholm, on "Effects of Catecholamines on Behavior and Body Function"; Dr. Paul J. Flory, Jackson-Wood professor, Department of Chemistry, Stanford University, on "The Motif of Macromolecular Structure"; Dr. Edward O. Thorp, Associate Professor, Department of Mathematics, University of California at Irvine, on "Some Mathematical Problems in Game Theory and Utility Theory"; Dr. Polykarp Kusch, Professor of Physics, Columbia University, on "Development of Knowledge of the Electron"; Dr. George C. Pimentel, Professor of Chemistry, University of California at Berkeley, on "Chemical

Lasers and Rapid-Scan Infrared Spectoscopy"; Dr. Oliver G. Selfridge, Research Staff Member, Lincoln Laboratories, M.I.T., on "Instructive Talks with Computers"; Dr. Marvin Chodorow, Director, Microwave Laboratory, Stanford University, on "Acoustical Phenomena at Microwave Frequencies"; Dr. Jesse L. Greenstein, Professor of Astrophysics, California Institute of Technology, on "Aspects of Stellar Evolution"; and Dr. Ward Edwards, Professor of Psychology and Head of the Engineering Psychology Laboratory, University of Michigan, on "Emerging Technologies for Making Decisions." In addition to the regular presentations, Mr. Walter Sullivan, Science Editor of The New York Times, discussed "The Search for Intelligent Extraterrestrial Life" at a dinner meeting co-sponsored by the New Mexico Academy of Science, and moderated an informal discussion on "Research Communication."[8]

The 1966 seminar was dedicated to the memory of Dr. W. Randolph Lovelace II, late president of the Lovelace Foundation for Medical Education and Research, who died in the crash of a private airplane in December 1965. This dedication was in recognition of the contributions of this outstanding medical scientist to the solution of problems in aerospace medicine and to his devotion to the concept of basic research. For his efforts advanced the search for causes of human suffering and their elimination and furthered the understanding of man in flight and in space. The Lovelace Memorial Lecture was delivered by Dr. U. S. von Euler, Professor of Physiology at the Karolinska Institute, Stockholm, Sweden, and a renowned scientist who was president of the Nobel Foundation.

## DCS/Plans and Programs

In the Directorate of Test Support considerable effort was expended on short notice, in March and April, to obtain support for Project "Blue Ice," a seismic noise study on the Greenland Ice Cap. These efforts included arranging for base support from the Air Defense Command (ADC) at Thule AFB, airlift support for the field party by the Alaskan Air Command (AAC), and

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[8] AFOSR, The Eleventh AFOSR Science Seminar on Challenge and Promise: Emerging Concepts in Basic Research (prospectus).

diplomatic clearance from the Danish government.[9]

Activity associated with the Churchill Research Range (CRR) was reduced to monitoring of the Air Force Cambridge Research Laboratories launch activities, USAF funding of Range operation, and acting as advisors to DOD members of the Joint Range Policy Committee.

In the Aerospace Research Support Program (ARSP), activity was continued to establish ARSP as a DOD program. Most of this activity was associated with clarifying and defining the role and mission of ARSP and the Space Experiments Support Program (SESP) of Space Systems Division (SSD), Air Force Systems Command (AFSC), in carrying out the overall DOD satellite research and development program.

There were three space launches during this period. The OV1-4 and OV1-5 (Orbiting Vehicle) satellites were successfully orbited from the Western Test Range, on 30 March, by a single Atlas booster. This was the first time a single booster was used to place two separate scientific satellites into two different orbits. The two satellites rode into space in the nose chamber of the Atlas, but each one carried its own solid-fuel rocket for the second stage of its journey into space. These satellites were placed in two distinct polar orbits with very near the designed orbital parameters.

The OV1-4, with a payload of about 83 pounds, had three missions: (1) to determine the zero gravity effect upon photosynthesis and the growth of green plants; (2) to determine the effect of weightlessness on the growth, reproduction, and gas exchange rates of duckweed; and (3) to study the effectiveness of temperature control coating systems. The OV1-5, with a 142-pound payload, was to measure the optical radiation characteristics of the earth, background, and space to provide a base for the development of earth surveillance techniques.

Both vehicles were designed to transmit experimental data for 90 days to ground stations at Cape Kennedy, Antigua, Ascension Island, and Hawaii.

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[9] DCS/Plans & Programs, "Semiannual Historical Report for the period 1 January - 30 June 1966," 31 Mar 67.

Actual satellite life should be much longer. OV1, for instance, was launched last October and is still transmitting data. With the exception of the photosynthesis experiment on OV1-4, all on-board experiments have produced the required data.

The OV3-1 satellite was launched by a Scout booster from the Western Test Range, on 22 April, into a near-perfect orbit. The launch was orginally scheduled for 19 April, but was scrubbed at T-2 minutes on that date because of a malfunction in the ground support equipment. The satellite measured the energetic charged particle environment in the near-earth space. Although the booms did not extend, excellent data was obtained.

Then, on 10 June, the OV3-4 satellite was successfully orbited, by a Scout booster, from Wallops Island. The launch was originally scheduled for sometime between 2300 hours, 6 June, and 0100 hours, 7 June, but was delayed because of a possible conflict with the orbital support requirements of the Gemini and Orbiting Geophysical Observatory (OGO) programs. The experiment was provided by the Bioastronautics group of the Air Force Weapons Laboratory. It provided spectral and depth dose measurements in the inner VanAllen radiation belt. The data obtained was used to determine the parameters for various computer prediction codes. Ultimately, the Weapons Laboratory hopes to be able to predict values of dose and dose rate received by manned space missions using the computer codes, the missile profile, and the spacecraft configuration. Excellent data was obtained from the test.[10]

On 7-9 March, representatives of the Engineering Sciences Division attended the OAR Rocket Propulsion Laboratory Meeting held at Edwards AFB, California. The meeting was arranged to jointly examine the R&D efforts of the two organizations, their goals, their plans, and to define research and management efforts which might achieve greater mutual support between the two organizations. Among the subjects discussed were: exchange of research information, mechanism for the evaluation of unsolicited proposals, transfer of funds between the two organizations, and viewpoints on research. The Air Force Rocket Propulsion Laboratory (AFRPL) asked OAR to place emphasis

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[10] Ibid.

on research in high energy sources. Here, high energy sources refers to the trapping of energetic particles or the stabilization of high energy states and mechanisms for release and use of this trapped energy for propulsion. The OAR position was that research in this area is very risky, but that AFOSR will continue to look for good proposals and will attempt to give them priority.[11]

The Engineering Sciences Division also was responsible for the management of the OAR Research Applications Conference on 5 April.[12]

The Office of the Assistant for Limited War (RROW) was established in May 1966. Actually, a major OAR interest in limited war developed in 1964 and 1965 when OAR members served on the working groups of the Scientific Advisory Board (SAB) Tactical Air Capabilities Task Force. In October 1965, Brig. Gen. Edward B. Giller (AFRST) in a letter to OAR, inquired of the contributions the OAR Research Program were making to the SEA conflict. A study was undertaken OAR's DCS/Plans and Programs to show the Air Force relevance of all active OAR research projects. A matching of the research projects with items from a listing of Air Force problem areas was accomplished. This study, presented to General Giller in December 1965, acted as a stimulant to induce more thinking in OAR about the problems of SEA and limited war. That same month, Major R. E. Jacobson, of OAR's DCS/P&P, was given additional duty as the Hq OAR focal point for SEA. He attended the weekly AFSC briefings to the Air Staff on the limited war projects such as those documented under Project 1559 and SEAORS. Maj. Joseph P. Martino of AFOSR, attended many of these briefings also. Then, in December 1965, SEA focal points were designated in each of the OAR laboratories.

On 7 January 1966, a secret SEA briefing was presented for OAR at the Pentagon. Following the Pentagon briefing, a meeting was held in OAR at which time the laboratories were encouraged to respond to the limited war needs. Copies of Dr. David Langmuir's letter to General Pinson on

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[11] Ibid.

[12] See Meetings, Conferences, and Symposia, page 21.

the relationship of research to the Vietnam conflict were handed out.

The Scientific Advisory Group (SAG) held a meeting in Los Angeles on the 25th and 26th of February, in which the topic under discussion was OAR's role in limited war. A Hq USAF representative briefed the SAG on the operational activities of the Air Force in SEA. Mr. Harold Ball, of Aeronutronics, formerly manager of ARPA's Project AGILE, expressed his views on the scientific community's responsibilities in the SEA conflict. Dr. Ball discussed the ten most serious problems of the SEA conflict, the subjects of a conference he attended in Puerto Rico earlier in February. In March, copies of the reports resulting from the Puerto Rico conference were obtained and forwarded to the limited war focal points in the OAR laboratories.

On 5-7 April, the Scientific Advisory Board (SAB) held its meeting at the Air Force Academy, Colorado, where the same ten SEA problems were discussed. General Pinson, Major Jacobson, and representatives from ARL and AFCRL, were present. The reports of this meeting and the Puerto Rico conference were used in OAR Planning Group sessions which explored potential research goals relevant to limited war problems. During the SAB meeting, through informal discussions, the OAR limited war focal points became aware of the study the Air Staff was conducting called operation SHED LIGHT. Later in April, both AFCRL and ARL submitted proposals to the Air Staff for new efforts to be considered for the SHED LIGHT program. Three of the AFCRL proposals and one ARL proposal were approved as valid SHED LIGHT efforts and OAR was directed to proceed with their development. The titles of these efforts were:

a. ISOCON TV Amplification (ARL)
b. Resonant Region Radar (AFCRL)
c. Airborne Reconnaissance Magnetometer (AFCRL)
d. Environmental Factors for LLLTV (AFCRL)

An AFCRL proposal on tunnel detection was sent to ARPA by the Air Staff and eventually was approved as ARPA Order 519. A proposal from ARL on a boron burner concept to provide airborne illumination looked attractive but it was recommended that the ARL scientists discuss it with the Air Force Armament Laboratory (AFATL) at Eglin AFB, before it was accepted as a SHED LIGHT effort.

On 2 May, OAR and AFCRL representatives visited the Aeronautical Systems Division's (ASD) Limited War Office at Wright-Patterson AFB, Ohio, concerning assignment of the responsibility to satisfy the tasks of Project 1559, on meteorological equipment, from the Limited War Office to AFCRL. It was agreed that AFCRL would be transferred funds for the procurement of such equipment. Of immediate concern were the cricket/sonde, balloon abort device and convert ceilometer. Discussions were held with representatives from ASD's Limited War Office. A week later, on 9 May 1966, Maj. Jacobson briefed General Pinson on the ways OAR could contribute to solving the problems of the SEA conflict and of other limited wars.

As a result, OAR concluded that it should establish an office dealing with limited war, and, in order to keep informed of the Air Force limited war problems and the plans to solve these problems, it should offer to send a representative to the Limited War Office at Wright-Patterson AFB for an extended period of time. The plan, as it was finally approved, called for an OAR representative to remain with the Limited War Office for a minimum of 60 days, and that the man so designated would not act as a mere liaison officer but would get involved with the limited war projects as though he belonged to the Limited War Office. The OAR individuals were to be exposed to all of the elements of the Limited War Office and would be invited to attend briefings and other presentations for the purpose of becoming well informed. Maj. Jacobson of Hq OAR was selected to represent OAR at the Limited War Office on the first tour beginning in June.

Major Jacobson was placed on full-time duty with limited war activities as of 10 May. Lt. Col. Durwood B. Williams of Hq OAR, was assigned as the Assistant for Limited War shortly thereafter, with Maj. Jacobson reporting to him. On the 19th of May, all the OAR limited war focal points met at Hq OAR, and, on 26 and 27 May, a briefing team from Hq USAF travelled to ARL and AFCRL to brief OAR scientists on Operation SHED LIGHT and the problems of aircraft vulnerability and communication systems. On 2 June, Maj. Jacobson departed OAR for his 60-day tour with ASD's Limited War Office at Wright-Patterson AFB. On 10 and 11 June, a SAG meeting, emphasizing the role of OAR in limited war, was held at Los Angeles and on 14-15 June, OAR representatives attended an ARPA-sponsored symposium on

counter-insurgency research and development called CIRADS.

## DCS/Materiel

Although an Industrial Engineer for administration of the OAR Value Engineering Program was approved for the Logistics Plans Division of the Directorate of Logistics, the position was reevaluated as to its applicability within Hq OAR. As a result, the Headquarters determined that maximum results most likely would be obtained if this position were located at the Air Force Cambridge Research Laboratories (AFCRL). Action has been taken to transfer the position to AFCRL. The duty of the incumbent will be to develop and administer the Air Force Value Engineering Program within OAR.[13]

The FY 1968-72 Military Construction Program was announced in March. The program was as follows:

(1) FY 1968 - Energy Conversion Laboratory, ARL

(2) FY 1968 - Science Laboratory, Optical Physics, AFCRL

(3) FY 1969 - Planetary Observatory, AFCRL

(4) FY 1969 - Library Research and Professional Building (addition), AFCRL

(5) FY 1970 - Science Laboratory, Astrophysics, AFCRL

(6) FY 1971-72 - None

All contracts have been let and the ground has been broken for the construction of the Vacuum Tower Telescope at the Sacramento Peak Upper Air Research Site near Alamogordo, New Mexico. Completion is scheduled for April 1968.[14]

A Cost Reduction Review Committee consisting of a member from each staff agency has been established. The committee reviews and approves submissions, stimulates program interest and participation, and establishes

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[13] DCS/Materiel "Historical Report, RCS: AU-D5, 1 January - 30 June 1966," 8 Aug 66.

[14] *Ibid.*

parameters for the OAR program. A semiannual report of Cost Reduction Program promotional items is now submitted to Hq USAF.

The original FY 1966 Cost Reduction goal of $3,610,000 was increased to $11,210,000 by the Air Staff. The revised FY 1966 goal was exceeded during the third quarter. Final figures for the FY 1966 dollar report will not be available, however, until late in the FY 1967 first quarter.[15]

OAR procurement activities during January-June 1966 accounted for 542 procurement actions for a total obligated amount of $31,659,800. Of the total, $21,150,000 and 306 actions were for contracts and $10,509,800 and 236 actions were for grants. The FY 1966 totals were: $69,325,900 obligated for 946 procurement actions; $49,099,700 for 506 contracts; and $20,226,200 for 440 grants. Low Cost Procurements (items of less than $2,500) procured in the OAR research laboratories at AFCRL, ARL, and FJSRL, amounted to 8,486 actions and 19,92? line items for a total obligated amount of $726,500. These purchases included petty cash and calls against Blanket Purchase Agreements. The FY 1966 totals were: $1,365,800 obligated, for 16,152 procurment actions, 36,991 line items.[16]

The only OAR base procurement activity is the one at EOAR in Brussels, Belgium. EOAR transacted 158 base procurement actions for 443 line items for $10,356. The FY 1966 totals for EOAR were: $28,125 obligated, 330 base procurement actions, 853 line items.

The Hq OAR Petty Cash expenditures amounted to $5,745 on 200 actions for 359 line items. The average monthly expenditure was $957. The FY 1966 totals were: $10,501 expenditures, 354 actions, 616 line items, and average monthly expenditure of $875.

The Directorate of Procurement renewed 27 basic agreements for another twelve-month period and negotiated 21 amendments to exising agreements. One new basic agreement was negotiated. Final overhead rates were negotiated with 20 educational institutions of which 6 were predetermined rates. During the reporting period, two institutions changed to predetermined overhead

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[15] Ibid.

[16] Ibid.

rates. A total of 18 universities are now using predetermined overhead rates, permitting prompt closing of completed cost type contracts. The Directorate also administered Air Force Advance Payment Pool Agreements with 14 educational institutions. These agreements had a total authorized amount of $22,385,000.[17]

Office of Scientific and Technical Information

Colonel James A. Fava, Director of the Office of Scientific and Technical Information, was reassigned in April. Major Carlton M. Smith, Chief of the Executive/Intelligence Division, served as Acting Director for the remainder of the January-June reporting period.

Besides the regular work on the OAR Research Review, Air Force Research Resumes, OAR Cumulative Index of Research Results, Air Force Research Objectives, etc., the Office of Scientific and Technical Information also provided editing, planning and scheduling support to the Headquarters' Office of Manpower and Organization for its revised Organization and Functions Handbook, and to the DCS/Plans and Programs for its Proceedings of the OAR Research Applications Conference, 5 April 1966. The first issue of the Hq OAR Consolidated Distribution List (as of 31 January 1966) was published and distributed.[18]

During this reporting period, after an unhappy and fruitless experience with private contractors bidding on the publication of the 1965-1966 Resumes, the Office of Scientific and Technical Information decided to publish this document in-house. Besides eliminating a great deal of confusion, in-house publication will save the Government a substantial amount of money (at least $30,000). Through the close cooperation of the Office of Scientific and Technical Information and the Superintendent of Documents, U.S. Government Printing Office, the OAR Research Review is now available for sale by

[17] Ibid.

[18] Office of Scientific and Technical Information, "Semiannual Historical Report (RCS: AU-D5) for Period 1 January 1966 to 30 June 1966," 25 Aug 66.

the Superintendent of Documents at $2.75 per year (domestic) and $3.50 per year (foreign). To date, the Superintendent of Documents has 650 paying customers for the <u>Review</u>. As this has resulted in a cost saving to Hq OAR, it is anticipated that the possibility of putting other Hq OAR publications on sale through the Superintendent of Documents will be studied. This would curtail Hq OAR's printing requirements and result in further savings.[19]

A survey was made of all recipients of the <u>OAR Quarterly Sumposia Report</u> in order to ascertain whether this document was a duplication of the DOD publication on symposia, and to determine whether or not the OAR publication should be eliminated. As a result of a study based on this survey, it was recommended that the OAR publication could be eliminated if the DOD publication incorporated a chronological breakout of the symposia by scientific area and a short description of each symposium, its purpose and background. The study and recommendation were forwarded to Hq USAF, which supported this approach, for transmittal to DOD.

The Office of Scientific and Technical Information and the Director of Data Automation have been experimenting with various approaches in an attempt to develop a simplified corporate-author[20] list which could be used for all Hq OAR publications, and which would exclude unnecessary and time-consuming decision-making on the part of the user. Corporate-author listings originated from library-catalog file cards which, in themselves, were not suitable for a data processing system. Proper names used as corporate names are shown in either normal or inverted (last name first) order. Foreign names may appear anglicized or in their original language. This resulted in confusion for the user of the listings in that he had to make decisions based on inadequate knowledge of the system through which he was searching. The Office of Scientific and Technical

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[19] <u>Ibid</u>.

[20] An institution issuing a report or having the scientific, technical, editorial or contractual responsibility for the report.

Information is considering a telephone book approach in which the names of the corporate authors, as preferred by the authors themselves, would be listed in strict alphabetical-numerical sequence, a standard data-processing arrangement. A two digit state-country code would also be used to permit machine sorting based upon geographical area.

During this period, 2200 individual and 150 group scientific interest profiles were delivered to OAR by Herner and Company. The final delivery climaxed a program OAR initiated in April 1965 to identify the scientific and professional interests of scientific and engineering personnel located in various Air Force RDT&E establishments. The profiles were a compilation of scientific terms chosen from the Datatrol Vocabulary to represent the precise interests of an individual or group of individuals. The initial test and application of the profiles will be in a Selective Dissemination of Information (SDI) system to be developed by OAR which will use OAR technical documentation as a data base. OAR also funded the participation of 200 Air Force scientific and engineering personnel in the National Aeronautics and Space Administration (NASA) SDI system. During this period the system became fully operational and provided Air Force personnel with a biweekly technical document announcement service tailored to their specific interests. OAR's objectives were to gain experience with SDI systems in both developmental and operational phases through participation in the NASA system from its beginning. OAR's requirements for continued participation should not exist beyond FY 1967.[21]

## Air Force Office of Scientific Research

The National Academy of Sciences - National Research Council (NAS - NRC) announced, on 18 April, that fifteen outstanding young scientists had been named to participate during the next academic year in the Postdoctoral Research Program supported by the Air Force Office of Scientific Research (AFOSR). The AFOSR-sponsored Postdoctoral Research Program, now in its

[21] Office of Scientific and Technical Information, "Semiannual Historical Report (RCS: AU-D5) for Period 1 January 1966 to 30 June 1966," 25 Aug 66.

sixth year, provides young investigators of superior ability with special opportunities for advanced study and fundamental research in areas of the natural and applied sciences which are of particular importance to the Air Force as sources of future technology. The minimum value of research awards under the program is $9,000.

Selections were made by a board of senior scientists appointed by the NAS-NRC and were based on demonstrated competence and creativity in original research, and on the scientific merit of the proposed postdoctoral investigation. Each applicant had to be nominated by a scientist of high professional standing. Candidates could choose the educational institution or research laboratory best suited for the conduct of work in their particular specialty.

## Air Force Cambridge Research Laboratories

Beginning in January, two radio telescopes (28- and 8-foot dishes) at AFCRL's Sagamore Hill Observatory, were being used full time to monitor solar radio noise on continuing, long-term basis at five dif erent frequencies——606, 1415, 2700, 5000, and 8800 mc. The purpose of the program was to determine how changes in radiation in certain frequencies correlate with solar and terrestrial effects—solar proton showers, solar flares, magnetic storms, auroral displays, and radio communications blackout. The Sagamore Hill astronomers hope to determine whether characteristic changes in radio emissions can be used as a basis for predicting environmental effects.

Scientists at AFCRL's Meteorology Laboratory conducted a series of fog dissipation tests in January at two American air bases in Germany. The tests consisted of suspending blocks of dry ice from ordinary weather balloons sending them aloft into the fog. As the fog particles came in contact with the dry ice, snow crystals formed and dropped to the ground, thus dissipating the fog. On 27 February, Air Weather Service (AWS) personnel at Griffiss AFB, New York were given a chance to put the new AFCRL method to a real test. It was necessary to clear a landing corridor for a distressed B-52 bomber. Using the AFCRL technique, AWS personnel opened a one-mile wide corridor along the full length of the runway to permit the

crippled B-52 to land. The corridor was opened in about an hour. The temperature at the time was 22 degrees Fahrenheit.

At a Pentagon ceremony, on 23 June, General John P. McConnell, Air Force Chief of Staff, presented Captain James T. Neal, of AFCRL's Terrestrial Sciences Laboratory, with the Air Force R&D award. Captain Neal was one of five Air Force officers to receive the award. Recipients of the award were selected by a committee from the Air Force Scientific Advisory Board. Captain Neal received the award for his research on dry lake beds suitable for aircraft emergency operations. The study of dry lake beds, their evolution, and geology, resulted in a voluminous report that could be considered a definitive document on dry lake beds in the western United States.

More than 30 leading scientists investigating the size, shape, and mass distribution of the moon, attended the International Conference on Selenodesy, held in Manchester, England, from 29 May through 4 June. AFCRL and the University of Manchester co-sponsored the event.

The third and last increment of projects to be funded under AFCRL's FY 1966 Laboratory Director's Fund (LDF) was announced by Col. Robert F. Long, Commander, AFCRL, in April. With these three programs, a total of 11 major programs have been funded under the FY 1966 $1.9 million allocation. AFCRL representatives expressed the opinion that they expected the FY 1967 allocation to be roughly the same size. Receiving funds under the last increment were: Russ Walker, Optical Physics Laboratory, for work on earth and horizon infrared measurements; A. T. Stair, Optical Physics Laboratory, for work on molecular interactions at 1 to 10 ev.; and Duane Haugen, Meteorology Laboratory, for work on instantaneous point source diffusion probes. A late entry in May for LDF funding, included Edward Chernosky, Space Physics Laboratory, for a feasibility design study of a portable, high-sensitivity, magnetic gradiometer for limited war applications.

On 29 March, an $85,000 addition to AFCRL's Optical Physics facility was accepted for occupancy. The new addition provided an environmentally controlled, dust-free laboratory for research on optical techniques related to reconnaissance, surveillance and communications. Construction was started on 18 April on a $24,500 expansion of the building now occupied by

the Lunar Planetary Research Branch of the Space Physics Laboratory.

Hans E. Hinteregger of AFCRL's Upper Atmosphere Physics Laboratory was named by the Air Force as one of its five nominees for the 1966 Department of Defense Distinguished Civilian Service Award. Hinteregger's scientific contributions in the field of solar physics, ionospheric physics, and extreme ultraviolet solar radiation are internationally recognized. In the past two years, two AFCRL scientists have received this award— Norman Rosenberg of the Upper Atmosphere Physics Laboratory in 1964 and John Evans of the Space Physics Laboratory in 1965.

Construction of a unique solar telescope at the Air Force Cambridge Research Laboratories' Sacramento Peak Observatory at Sunspot, New Mexico, began in the spring. Design concepts for the telescope were established by an AFCRL scientist, Dr. Richard Dunn. Plans call for its completion early in 1968.

The $3.16 million telescope will be 326 feet long; 200 feet of this length will be beneath ground level. The above-ground segment will rise 126 feet on a peak of the Sacramento Mountains, which are 9,200 feet above sea level. With the completion of the new telescope, the Sacramento Peak Observatory, already a major solar research center, will become one of the most complete facility in the world for the study of solar phenomena.

The above-ground portion of the telescope will consist of a truncated, cone-shaped tower and associated laboratory buildings. The base of the 126-foot tower will have an inside diameter of 40 feet. The diameter will narrow to 20 feet at the top.

Atop the tower will be a rotating turret for tracking the sun in elevation and azimuth. Light from the sun will pass through a quartz window having a 30-inch aperture onto flat mirrors mounted in the turret. The mirrors will direct the light down a long 320-foot tube to a spherical mirror at the bottom. This spherical mirror will have a diameter of 64 inches and focal length of 180 feet. By tilting the mirror, light can be directed upward to any one of five observation ports in the associated ground facilities.

Two design features should give the telescope exceptional flexibility and resolution. The first is in the mounting of the optical system. The

entire optical system, including the 320-foot interior tube and associated instrumentation, will rotate as the sun is tracked. This system will weigh approximately 250 tons. The second feature is that the optical system and associated instruments will be placed in a vacuum. The purpose of the vacuum is to eliminate air turbulence, which can greatly affect the resolution of the telescope. An added advantage of the vacuum is the elimination of dust from optical surfaces that would degrade resolution and sensitivity. Two vacuum pumps will evacuate the entire optical system and associated instruments to working pressure in about six hours, displacing 17,000 cubic feet and obtaining a vacuum of .25 torr, which corresponds to an altitude of 180,000 feet.

The new facility is closely linked to the nation's space programs. Of prime concern are high proton showers associated with sunspot activities. These showers provide a great potential hazard to man in space, and degrade electronic equipment. The study of characteristic features on the surface of the sun which give rise to these showers will receive special emphasis. From these studies, AFCRL scientists hope to extend the period over which they can predict the onset of proton showers. Predictions can now be made with considerable accuracy over a 10-day period.

In addition to research leading to the more precise prediction of dangerous proton showers, the new telescope will be used for research on a range of solar phenomena. Solar activities have a profound effect on the earth's weather and on communication and detection systems. AFCRL scientists hope to obtain a clearer picture of solar-terrestrial relationships.

Scientists of the Air Force Cambridge Research Laboratories and Cornell University jointly conducted a series of experiments designed to learn more about dense, patch layers of the ionosphere known as sporadic E.

Sounding rockets, which released a vertical chemiluminescent trail starting at 30 miles and extending to a peak altitude of 180 miles, and the 1000-foot Arecibo radar in Puerto Rico, were used to obtain precise data on ionospheric and wind conditions under which sporadic E forms.

A series of four rocket firings were made from Camp Tortuguera, Puerto Rico. This was timed with simultaneous measurements made at Arecibo using

a lower-ionosphere study program. The rocket trajectory and radar beam intersected at a height of approximately 100 km, some 20 km north of Arecibo over the Atlantic Ocean. The measurements were made at night, and were spaced between sunset and sunrise on a night when sporadic E was detected by radio means at Arecibo. The particular night chosen required the cooperation of both local weather conditions for a clear observation of the trails and the mechanism which produced the sporadic E phenomenon.

Sporadic E occurred randomly and unpredictably, and affected both radio communications and radar detection——usually in a harmful way. Depending on radio or radar wavelengths, the signal was either absorbed or reflected, causing such effects as radar clutter, signal fading, or the reflection of the signal over great distances.

Although sporadic E layers have been studied for many years, just how they were formed was not well understood. One promising theory, known as the "Wind Shear Theory," predicted that charged particles in the lower ionosphere would be forced to pile up into thin layers because the particles were moving relative to the earth's magnetic field. The magnetic field deflected the particles vertically, with the amount of deflection depending on the direction and velocity of the wind at any given altitude. Because the 100- to 150-mile per hour wind changed direction by 180 degrees at roughly 15-mile intervals, luminescent trails produced by rocket firings were distorted and assumed a helical configuration. Thus, the moving charged particles cut across the lines of force of the earth's magnetic field at all angles, and were consequently deflected more strongly at given altitudes. This caused them to pile up at certain altitudes, thereby creating sporadic E.

To evaluate this theory, it was necessary to know more about wind shear——that is, the change in wind direction with altitude. High-altitude wind profiles were measured by releasing a luminescent chemical vapor from a rocket as it proceeded along a nearly vertical trajectory. These trails were tracked by cameras, and the height profile of wind magnitude and direction was obtained from the cloud motions as recorded on the films.

Starting in May, a month-long airborne geological survey over several

Mediterranean and Middle East countries to collect data on dry lake beds for natural landing areas was undertaken by AFCRL scientists. They were also investigating the geology of river valleys and volcanic geothermal areas.

The key instrument aboard the C-130 aircraft was a nine-lens camera system for taking simultaneous photographs at nine different narrow-band regions of the visible and near-infrared spectrum. By studying the tonal contrasts of the photographs, characteristics of the terrain can be determined. In addition to the nine-lens camera, a thermal infrared optical-mechanical scanner and a conventional aerial camera were used.

The survey was made over Libya, Iran, and Jordan. As an adjunct to the survey, AFCRL, at the request of the Italian Government and Dr. Froelich Rainey of the University of Pennsylvania Museum, used the instrumented aircraft to examine the Plain of Sybaris on the southern coast of Italy in an attempt to locate the lost city of Sybaris, the richest of the pre-Golden Age Greek cities. It was hoped that the AFCRL survey using the nine-lens camera and the thermal infrared system could help delineate the boundaries and other features of the lost city.

Another feature of the survey was an attempt to locate geothermal areas which can serve as natural-energy sources for steam electric power generators. Such generators have been in use in Italy for a number of years. The thermal infrared scanner was used for this survey which was made in the Larderello area. The area around Mt. Vesuvius was also mapped.

The main object of the survey was the location of large, dry, flat areas with soil sufficiently compact to support aircraft. During the past four years, AFCRL has made extensive studies of dry lake beds in the western United States, and has identified and cataloged scores of such natural landing areas suitable for emergency operations. The recent airborne survey further helped identify such areas in the Middle East.

The nine-lens camera was developed by the Itek Corporation, Lexington, Mass., and the IR scanner by Michigan University, both under the direction of AFCRL scientists.

An AFCRL satellite, instrumented to measure the angular distribution and energies of charged particles in the earth's magnetic field and upper

ionosphere, was launched from Vandenberg AFB, California, on 22 April. The OV3-1 (Orbiting Vehicle) satellite was boosted into a polar orbit with an apogee of 3,090 nautical miles, a perigee of 192 nautical miles, a period of 151 minutes, and an orbital inclination of about 80 degrees, by a Blue Scout rocket.

The specific objective of the launch was to determine the distribution of energetic charged particles (electrons and protons) in the earth's magnetic field. AFCRL scientists are primarily interested in the pitch angle of the particles (angle of the particles with respect to the magnetic field).

The satellite carried a spherical electrostatic analyzer for measuring low-energy ionospheric charged particles, and two curved-plate electrostatic analyzers for measuring high-energy radiation belt electrons and protons up to about 100 Kev. Two other instruments, an electron spectrometer and a proton spectrometer, were aboard to obtain the energy spectra of particles up to an energy of a few Mev. Also, a Geiger counter was used to measure the radiation counts in order to compare radiation-intensity data with that obtained in previous AFCRL satellite measurements made between 1960 and 1963.

All of the instrumentation was directional except for the spherical electrostatic analyzer and the Geiger counter, which were omnidirectional. Two sets of standard aspect magnetometers were also on the satellite for determining the orientation of the directional instruments with respect to the magnetic field.

Extensive modifications of AFCRL's Boeing KC-135 upper atmosphere research aircraft were completed by the Lockheed Aircraft Service Company. Part of AFCRL's fleet of airborne laboratories, the KC-135 was equipped to probe the ionosphere.

Most important of the new modifications was the installation of a second hemispheric dome atop the fuselage to accommodate a gyro-stabilized 35 mm. all-sky camera and a Granger ionospheric sounder. Regarded by project scientists as the most important unit in the aircraft, the sounder is a pulsed radar that is stepped from 2 to 64 megacycles. In an effort to map the ionosphere, scientists use the sounder to measure densities,

movements, irregularities and currents of electrons. The other dome houses the head for the photometer used to measure artificial and natural airglow.[22]

A periscope, located between the two domes and interlocked to directional cameras and a photometer, could be coupled by servo-mechanisms to instruments in both domes. Also installed was new control equipment that would permit all cameras in the airplane to be controlled by one operation. Still another addition was the installation of a new gamma ray monitor that would be used in cosmic radiation studies. Nearly all other research equipment already installed in the aircraft was revised and reinstalled in compact rack arrangements, so as to provide more room for the crew. This unique aircraft, with its great variety of instrumentation, permits AFCRL scientists to conduct ionospheric studies all over the world. Studies have been made from the Arctic to the Antarctic in such areas as electrojet studies, aurora, airglow, Arctic propagation studies, ionospheric perturbations, and ionospheric densities.[23]

The first working flight of the refurbished flying laboratory left Hanscom Field, on 24 January, for the Azores. From there it flew on to Iceland and then back to Hanscom Field. During the course of the flight, AFCRL scientists studied the aurora, ionospheric drift and irregularities, and investigated electron dumping areas in the Middle and North Atlantic. Then, on 24 March, the flying laboratory left Hanscom Field again, that time on a month-long series of flights over the northcentral United States to evaluate instrumentation aboard the aircraft. This instrumentation was the most advanced and the most sensitive instrumentation for measuring gravity that had ever been assembled aboard an aircraft. Worldwide gravity surveys have lagged because of the difficulty in making measurements over oceans and in remote areas. The instrumentation aboard the KC-135 should help overcome this particular difficulty.

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[22] AFCRL Newsletter, No. 128, 14 Jan 66; Cambridge Laboratories KC-135 Equipped to Study the Ionosphere," Aviation Week and Space Technology, 10 Jan 66, p. 99; OAR Research Review, Vol V, No. 1, Mar 66.

[23] Ibid.

The solar eclipse that occurred 20 May across the eastern Mediterranean was observed by AFCRL scientists from AFCRL's KC-135 ionospheric aircraft and from a temporary ground site near Olympus, Greece. About ten AFCRL scientists participated in the program. Radio measurements were made in four frequency regions—X, C, S, and L bands. Two AFCRL equipment trailers were shipped to Greece, in March, for the ground observations. Ground observations were under the direction of scientists from the Space Physics Laboratory. Exceptionally good data was obtained by them. They were able to obtain excellent radio emissions from three different isolated sunspots. Airborne observations were primarily concerned with changes in the ionosphere induced by the eclipse. The AFCRL KC-135 aircraft, with its variety of instrumentation for looking at the ionosphere, was under the direction of scientists from the Upper Atmosphere Physics Laboratory. Following the eclipse, the two equipment trailers were sent directly to Peru, where the AFCRL group were to observe another eclipse on 12 November.

About 150 administrators and scientists from OAR and its elements, together with representatives from other Air Force organizations, attended the OAR Program Review on 7-10 February. Four panel sessions were run concurrently. These sessions were devoted to a review of all OAR defense research sciences and exploratory development programs conducted at organizations supported by OAR. All sessions were held in the AFCRL complex.

An environment test chamber for simulating atmospheric pressures and temperatures found at altitudes up to 216,000 feet was placed in operation at AFCRL's Aerospace Instrumentation Laboratory in January. The chamber was to be used to test and calibrate balloon-borne instruments at various simulated altitudes. It was capable of maintaining pressures as low as .75 torr, and temperatures from -112 degrees to +250 degrees Fahrenheit, and could simulate balloon flights of any programmed duration. The working area within the cylindrical chamber was 48 inches in diameter and 25 inches deep.

TSgt Forrest F. J. McClure of the Technical Services Division, Deputy for Logistics, AFCRL, was named OAR Outstanding Airman of the Year. He represented OAR at the Air Force Association Convention that was held in

Dallas, Texas, in March. The award was made on the basis of his outstanding contributions during 1965 to an AFCRL classified project. He worked with the system through construction, installation and checkout, and was the only project member who followed through on all its phases. He accompanied the equipment to the operating location and tested it under combat conditions, flying several combat missions in support of the project. He developed a set of operational instructions and instructed and supervised the user personnel in the field.

NASA's Surveyor program has been extensively supported by the Aerospace Instrumentation Laboratory during the past year. This support consisted of dropping Surveyor modules from balloons. Purpose of the effort, conducted at Holloman AFB, New Mexico, was to test attitude control systems and the retro-firing mechanism used to decrease the module velocity as it approaches the moon. In FY 1965, 16 launches were made under the program. Thus far in FY 1966, 24 Surveyor test launches have been made and two more are scheduled later this month. The balloons carrying the Surveyor landing module were tethered at 1,500 feet from where the 450-pound package was dropped. The Surveyor launches were only a small part of AFCRL's balloon activity in February, an exceptionally busy month for the balloon launch group. Altogether, 15 balloon launches are scheduled. Launched last week was Project Sky Top (for the Space Physics Laboratory) consisting of a telescope-spectrometer system which was carried to an altitude of 105,000 feet to make infrared measurements of the lunar surface.

In the remarkably short period of two months, scientists of the Data Sciences Laboratory conceived, developed, and field-tested an ingeniously simple system that enabled helicopter pilots to hear and to determine the direction of groundfire. The helicopter pilot in Vietnam often doesn't know he is being fired on from the ground until his helicopter is hit. If the hit isn't vital, he then begins to take evasive action. The problem is that the noise of the helicopter masks the sound of the small arms groundfire. The detection system was field-tested, on 9 March, at Camp Edwards. The position of a 7.62 mm. machine gun, firing short bursts of ammunition, was unfailingly pinpointed from the helicopter at distances up to 2[illegible] yards.

The Satellite Meteorology Branch of the Meteorology Laboratory has been receiving daily pictures from the ESSA II Weather Satellite for the past two weeks. Transmissions from the satellite are picked up by the helix antenna atop an AFCRL building and processed by the laboratory's Automatic Picture Taking (APT) equipment. The relatively high orbit of the satellite—750 miles—results in the coverage of a much larger area than the Tiros or Nimbus satellites. Most of the North American continent can be photographed in only four picture transmissions.

AFCRL was chosen by NASA and the Air Force as one of the seven key stations (from among 150) to evaluate the new experimental infrared system aboard NASA's new weather satellite, NIMBUS C. The NIMBUS C was launched 15 May from Vandenberg AFB. The Meteorology Laboratory's APT equipment was modified to accommodate transmissions of infrared photographs to be transmitted by NIMBUS C. The NIMBUS C took high resolution infrared nighttime pictures from its 600-mile circular orbit. The APT station was operated by AFCRL's Satellite Meteorology Branch which also recorded pictures from NIMBUS I, beginning in August 1964, and ESSA II, since March of this year.

AFCRL established a new West Coast office, on 6 June, at the Space Systems Division, El Segundo, California. The office has the organizational status of a laboratory. Gene DeGiacomo, presently Chief of the Space Forecasting Branch of the Space Physics Laboratory, has been named head of the West Coast office. The purpose of the new office is to provide consultation service to the Space Systems Division and Ballistic Systems Division, and for the deputy commander of the Manned Orbiting Laboratory (MOL) program. The new office maintains technical liaison with the Aerospace Corporation and provides engineering support to OAR's Los Angeles office. AFCRL scientists will, as occasions warrant, work on extended TDY with the AFCRL West Coast office.

A 26-million-cubic-foot-balloon, twice the size of any previous balloon, was launched by AFCRL from Holloman AFB on 22 June. The balloon system at the time of launch stood 815 feet above the ground, a height which compares with the 555 feet of the Washington Monument and the 1,250 feet of the Empire State Building. The 26-million-cubic-foot volume of the balloon

compares to the previous record balloon size of 13.5 million cubic feet, a balloon launched by AFCRL in January 1965. The balloon system was designed to test NASA's Voyager Mars landing capsule. Beginning in August, AFCRL plans to use five balloons of the same design to carry the Voyager test module to an altitude of 130,000 feet for simulation tests of entry into the Martian atmosphere.

The AFCRL-sponsored International Conference on Crystal Growth met in Boston on 20-24 June. More than 170 papers were presented by leading crystallographers from all over the world. Approximately 60 of the more than 500 attendees came from abroad.

## Aerospace Research Laboratories

The Aerospace Research Laboratories (ARL) announced in January that a patent had been awarded to Mr. Radames K. H. Gebel of its Solid State Physics Research Laboratory for his invention of the Sequential Light Amplifier System. Work on this system, the result of research under Project CAT EYE, was carried on by Mr. Gebel during the 1950's.[24] His interests in the possibility of amplifying light by electron means, ultimately led to a device capable of producing an image 50 billion times brighter than the actual scene it was focused upon. In other words, it produced pictures in what appeared to the naked eye to be total darkness. Besides being an important device in the fields of astronomy, medicine, and aviation, this concept has numerous military applications, not only by the Air Force, but by the entire armed forces.

Dr. Hans J. P. von Ohain, Chief Scientist at ARL, received the Goddard Award from the American Institute of Aeronautics and Astronautics (AIAA) at the AIAA Honors Convocation in New York City on 25 January. The award was named in honor of Dr. Robert H. Goddard, the rocket pioneer, and was established in 1963 by the AIAA and the United Aircraft Corporation (UAC). It is given to persons who have made a brilliant discovery or a series of

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[24] For complete details see OAR-4, Project Cat Eye: A History of Light Amplification Research at the Aeronautical Research Laboratory, 1952-1960.

outstanding contributions over a period of time in the engineering science of propulsion or energy conversion. The award consists of an honorarium of $5,000 donated by UAC, a certificate, and a medal donated by Mrs. Esther Goddard.

Dr. von Ohain's award was for his contributions toward the first successful application of turbojet propulsion to aircraft in 1939. He had develcped a theory of turbojet engines and built a working model as early as 1935-36. Working in conjunction with the Heinkel Aircraft Corporation in Rostock, Germany, he was able to develop the first successful sustained operation of a turbojet engine by March 1937. This first engine used gaseous hydrogen as a fuel. He intensified his research and produced a successful liquid-fueled engine which was installed in the first experimental jet airplane, the He-178. With this airplane the first flight of a turbojet-powered aircraft was made in August 1939. Continued development produced an improved turbojet engine which, when installed in a two-engine jet plane, propelled the aircraft at speeds up to 100 miles per hour faster than contemporary piston engine planes.

On 23 June, Major Robert M. Detweiler, Assistant to the Director of ARL's Solid State Physics Research Laboratory, was one of five USAF officers to receive the 1965 USAF Research and Development Award. It was presented to him for his outstanding research in the field of solid state physics. His research has added substantially to the present knowledge of the defect structure of semiconductors and the experimental techniques introduced by him have been universally recognized. His work is applicable in the development of new semiconductor devices and in providing better understanding of the general problems of radiation damage relative to its effect on Air Force weapons systems in the field.

This is the fourth consecutive year that a member of ARL has received the USAF Research and Development Award. In 1962, Dr. Robert E. Sievers received the award for his research in the area of gas chromatography. Then, in 1963, Dr. Gale I. Harris received it for his work in the field of nuclear physics, and finally, in 1964, Major Melvin R. Keller received the award for his research efforts in the field of energy conversion.

Colonel Robert E. Fontana, ARL Commander, received the Legion of

Merit, on 9 June, before leaving for his new assignment as Chief of the Department of Electrical Engineering at the Air Force Institute of Technology. Under the direction of Col. Fontana, according to the citation, notable scientific advancements have been made by ARL's scientific and technical personnel in numerous complex areas such as hypersonic wind tunnels, sequential light amplifier systems, molecular cross linking mechanisms, atom connectivity matrices, semiconductor materials, quantitative analysis of metals by gas chromatography, radial mathien functions, optimum designs of rocket nozzles, and energy conversion research. He also revised and supplemented the ARL scientific and technical programs to insure that new science has the maximum possible impact on Air Force technology on a continuing basis. Another of his most significant accomplishments was the guidance of officer and civilian scientists in career development.

Colonel Paul G. Atkinson, Jr., Deputy Commander of the Aerospace Research Laboratories, replaced Col. Fontana as Commander of ARL on 16 June. Col. Atkinson, who has been associated with propulsion research and development for over 15 years, graduated from the U.S. Military Academy in 1943. During World War II he served as a pilot and flight commander in Europe in the Ninth Air Force. He returned to the United States in 1945 and was assigned to Headquarters United States Army Air Forces until he entered the California Institute of Technology graduate school in 1946. After graduating with a Master's degree in aeronautical engineering, he was assigned to the Engineering Division of the Air Materiel Command (AMC) until December 1949. There, he served as Chief of the Test Range Branch of the Guided Missile Section and later as a project officer in the Power Plant Laboratory. During this time he also earned a Master's degree in business administration at Ohio State University. From 1950 to 1953, Col. Atkinson served as an intelligence officer in Germany.

He then joined Headquarters Air Research and Development Command (ARDC), serving as Chief of the Rocket Engine Section in the Aeronautics and Propulsion Division until May 1956. Transferring next to the Air Force Office of Scientific Research (AFOSR), he served as Chief of the Propulsion Research Division until 1960. From 1960 to 1965, Col. Atkinson was at Headquarters United States Air Force, where he was Chief of the Propulsion

Division in the Directorate of Science and Technology. In July 1965 he joined ARL as deputy commander.

Colonel Charles A. Scolatti, Chief of ARL's Operations Office, assumed Colonel Atkinson's former position as deputy commander of ARL. Col. Scolatti was commissioned in 1944 after completion of flying school. During the remainder of World War II he served with the Eighth Air Force in Europe. Upon his return to the United States, he instructed in the advanced single engine flying program, and in 1948 he was assigned to the Twentieth Air Force in Okinawa.

In 1950, Col. Scolatti went to Wright-Patterson AFB, Ohio, as an experimental test pilot in the Fighter Branch of the Flight Test Division. In addition to fighter testing, he worked with the automatic all-weather landing systems program and the jet fighter icing program.

From 1952 to 1954 he attended the Air Force Institute of Technology (AFIT) Engineering Sciences Program. Upon graduation Col. Scolatti was assigned as an aeronautical research engineer and project scientist in the ARL Fluid Dynamics Branch. He left ARL in 1958 to attend the Massachusetts Institute of Technology (M.I.T.). In 1960 M.I.T. awarded him the Master of Science and E.A A. degrees in aeronautics and astronautics. He has also been awarded a Master's degree in international affairs by George Washington University, Washington, D. C. Col. Scolatti then served as Chief of the Research Planning Division, Directorate of Plans at Headquarters OAR from July 1960 to July 1964. He spent the next year at the Air War College, Maxwell AFB, Alabama and came to ARL immediately after graduation.

## European Office of Aerospace Research

The European Office of Aerospace Research (EOAR) experienced minor reorganizations in both its Directorate of Technical Operations and its Directorate of Procurement. In the former, the reorganization was effective 1 May and was concerned mainly with bringing the EOAR organization in line with the Department of Defense (DOD) program element requirements. For instance, a project officer in the Metallurgical Sciences was transferred from the Physical Sciences Division to the Engineering Sciences

Division because one of the DOD program elements called for the field of Metallurgy to be placed in Engineering Sciences. Mostly, the reorganization involved the shifting of personnel on paper.

In the Directorate of Procurement, its reorganization was approved but would not become effective until 1 July 1966, at which time its four divisions would be reduced to three. The Sciences Division was to be absorbed into the Physics Division; the new structure to be entitled the Physics and Biosciences Division. The structure of the Engineering and of the Support Services Divisions remained the same.

As of 30 June, the European Office of Aerospace Research (EOAR) had a total of 503 active contracts and grants under administration, with a total value of $14,542,200. Unliquidated commitments were $4,550,531. This compares to 30 June 1965 figures of 528 active contracts and grants with a total value of $15,056,300 and unliquidated commitments in the amount of $6,547,300, and 31 December 1965 figures of 473 active contracts and grants valued at $13,246,300 and unliquidated commitments of $7,237,300. A list of contracts and grants by country (as of 30 June 1966) was as follows:[25]

[25] History of the European Office of Aerospace Research, Brussels, Belgium, 1 January - 30 June 1966, undated.

| Country | No. of Contracts/Grants | Total $ Value |
|---|---|---|
| Austria | 17 | $ 516,515 |
| Belgium | 35 | 889,871 |
| Denmark | 9 | 111,500 |
| France | 37 | 2,136,090 |
| Finland | 3 | 58,390 |
| Germany | 58 | 1,610,602 |
| Ghana | 1 | 12,000 |
| Greece | 5 | 209,039 |
| Ireland | 9 | 158,062 |
| Israel | 57 | 1,998,242 |
| Italy | 50 | 1,232,273 |
| Kenya | 1 | 11,250 |
| Lebanon | 2 | 37,900 |
| Netherlands | 6 | 270,420 |
| Norway | 20 | 981,301 |
| Spain | 9 | 149,902 |
| Sweden | 49 | 1,323,686 |
| Switzerland | 9 | 261,395 |
| Turkey | 3 | 27,985 |
| United Kingdom | 123 | 2,545,777 |
| TOTAL | 503 | $14,542,200 |

A total of 241 Purchase Requests, totalling $3,654,900 were received during FY 1966. In addition to these, there were eight FY 1965 Purchase Requests carried over and obligated during FY 1966. Most of the Purchase Requests received were in the 614 and 624 fund series.[26]

Fiscal Year 1966 Purchase Requests, numbering 232 and totalling $3,564,710 were obligated during the fiscal year for research. This was in addition to the eight FY 1965 Purchase Requests carried over and two supply Purchase Requests totalling $163,150. A breakdown of research and development obligations by country are as follows:[27]

| Country | No. of PRs Obligated | Total $ Value |
|---|---|---|
| Austria | 11 | $ 124,460 |
| Belgium | 16 | 213,755 |
| Denmark | 3 | 22,000 |
| Finland | 2 | 43,100 |
| France | 16 | 464,042 |
| Germany | 30 | 428,400 |
| Ghana | 1 | 5,000 |
| Greece | 4 | 28,700 |
| Ireland | 2 | 28,500 |
| Israel | 23 | 492,795 |
| Italy | 28 | 312,603 |
| Lebanon | 2 | 33,900 |
| Netherlands | 3 | 42,670 |
| Norway | 17 | 274,600 |
| Spain | 6 | 36,416 |
| Sweden | 19 | 288,312 |
| Switzerland | 4 | 61,000 |
| United Kingdom | 44 | 653,207 |
| TOTAL | 231 | $3,553,460 |

[26] Ibid.

[27] Ibid.

Barter funds were received by the London and Laon Finance Offices during this reporting period. The London Finance Office was scheduled to receive a total of $3,550,000 and the one at Laon $1,500,000. Barter fund requirements of $3,830,000 for the second increment beginning 20 February 1967 were requested. Hq OAR, in reviewing this request, rounded off the figure to $4,000,000.[28]

Because of the proposed relocation of units assigned in France, arrangements were made to transfer the payments of all contracts and grants from the Laon Finance Office to the office in Bitburg (Germany). This required the preparation and distribution of change orders and grant amendments on 162 documents. The Barter account was also changed to Bitburg.

At the same time, agreements were reached with the Office of Naval Research (ONR) and the Naval Purchasing Office, London, to transfer all Navy contracts to EOAR beginning 1 July 1966. This transfer involved approximately 50 contracts.

The big issue in the European Office of Aerospace Research during January-June 1966 continued to be the collocation efforts of the European R&D offices of the three armed services. This issue went back to 10 June 1964, when the U.S. House of Representatives requested that an inquiry be made into the procurement policies and practices of the Department of Defense, including major overseas procurement. This inquiry resulted in the House Surveys and Investigations Report of February 1965, which concluded that the work of the three military research offices in Europe was poorly coordinated and suggested a consolidation of the facilities and personnel involved. When the House Appropriations Committee called this matter to the attention of the Director of Defense Research and Engineering (DDR&E), he replied that such a consolidation could not only be effected but could lead to an improvement in overall efficiency. The Committee then called on DOD to accomplish this consolidation during fiscal year 1966.[29]

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[29] "History of the European Office of Aerospace Research, 1 January 1966 - 30 June 1966," 12 Sept 66.

Also as a result of the House Surveys and Investigations Report of February 1965, DOD directed a study of certain aspects of procurement activities of the three services in selected European countries. It was conducted by the DOD Procurement Management Review Group. The field effort was accomplished between 26 April and 7 June 1965. Concurrently with this review, a study was made by DDR&E relative to the research organizations of the three services in Europe. The DDR&E study concluded that research activities in Europe could best be accomplished by locating the research offices of the three services in one city, preferably the Frankfurt-Wiesbaden area in Germany. When and if the relocations of the research organizations were carried out, the DDR&E study recommended that the U.S. Army Procurement Center, Frankfurt, be assigned responsibility for procuring all research in Europe. These DDR&E recommendations were noted and included in the DOD Procurement Management Review Group's analysis.[30]

The Procurement Management Review Group recommended that if the DDR&E recommendations for relocation of the Army, Navy, and Air Force research operations in Europe were carried out, the responsibility for procurement for the three services should be assigned to a single procurement office. If the relocation were to be made in the Frankfurt-Wiesbaden area of Germany, it was recommended that the procurement responsibility be assigned to the U.S. Army Procurement Center, Frankfurt.[31]

On 10 September 1965, EOAR's Director of Procurement, attended the Tri-Service Procurement Directors' Meeting at Frankfurt, where he was provided with a copy of a report prepared by a DOD Procurement Management Survey team. The report had been forwarded to EUCOM (Army) for comment in anticipation of a consolidation of the R&D activities of the three services in Europe. Colonel Jack L. Deets, EOAR Commander, read the report and noted with alarm that EOAR's functions were greatly misrepresented. He reported his findings immediately to Hq OAR and recommended

[30] Ibid.

[31] Ibid.

that OAR protest these misrepresentations.

OAR prepared a position paper as well as their clarifying comments on Section A of the above report. Apparently OAR's protest efforts were effective, for, on 18 October 1965, DDR&E directed that a task force be assembled to make a comprehensive study of the practical problems involved in such an implementation by 1 February 1966.

This task group, of which Brig. Gen. Ernest A. Pinson was the USAF member and Col. Thomas M. Love the alternate, met on 30 November 1965 at Washington. The members determined that the basic study could best be conducted by the commanders of the services' research offices in Europe as a working group. In December, the European commanders were advised by letter to conduct a joint study and to prepare and submit a report to the task group in Washington not later than 20 January 1966. A Working Group, composed of Colonel Charles L. Beaudry, U.S. Army, Chief, Army Research Office - Frankfurt, Chairman; Captain William W. Schaefer, U.S. Navy, Commanding Officer, Office of Naval Research - London; and Colonel Jack L. Deets, U.S. Air Force, Commander, European Office of Aerospace Research - Brussels, was established and charged with the responsibility of studying and recommending a suitable site for collocating the three services' European Research and Development offices. In connection with this the European Working Group asked the various U.S. military commands in Europe for input data on the availability of housing, office space, support facilities and similar items, by 5 January 1966.

Anticipating such a request, Col. Deets had, in September 1965, directed his staff to gather data and information in order to prepare comparative reports on the three Tri-Service R&D activities, operations, and support capabilities. Thus, by the time the first negotiations meeting was held in January, Col. Deets was completely prepared with raw data on the total scope of R&D activities in Europe. The EOAR staff, therefore, was able to supply Col. Deets with current data and analyses for the three meetings of the Working Group in London, the two meetings in Frankfurt, and two meetings in Brussels.

By 20 January, the Working Group, chaired by Army Colonel Charles L. Beaudry, prepared and forwarded a 153-page report. In that report the

commanders of EOAR and ONR-London agreed that if the decision was made to collocate, Brussels, Belgium was the first choice as a site for the offices and London the second. Frankfurt was not recommended. The Army dissented. It recommended collocation at Frankfurt with the procurement responsibility given to the U.S. Army Procurement Center, Frankfurt. The task group in Washington, chaired by Navy Rear Admiral John K. Leydon, adopted the report as written following the same voting split as in Europe, with the Navy and the Air Force voting for approval of the report and the Army dissenting. The report was approved in like manner by the Service Secretaries and forwarded to the DDR&E, who accepted the report.

As a consequence of this study, EOAR prepared and executed implementation plans to accept the procurement responsibilities of the Navy program at Brussels. A detachment of the U.S. Navy Office of Naval Research was physically located with EOAR in Brussels and was staffed by Navy personnel. In addition, EOAR utilized the scientific liaison services of the Navy in its European program. The Air Force, in turn, sent two Air Force scientists to work on the Navy scientific staff in London. To date, the Army has declined to accept the offer to collocate at Brussels. In fact, a final decision with respect to the conclusions and recommendations of the report has not been rendered.

A side issue, but nonetheless important, developed as a result of the Group's deliberations. The commanders of EOAR and ONR-London agreed that the liaison activities of ONR-London should be expanded to include areas of interest to the Air Force. U.S. Air Force scientists and technicians were to be recruited by the Navy to fill positions on the scientific liaison staff of ONR-London. In turn, the skilled, responsive R&D procurement capability of EOAR would assume responsibility for the Navy's European R&D contract activities. A Navy commander was transferred to Brussels as the Navy's staff representative to monitor the Navy's European R&D contract program. This partial collocation of staffs of EOAR and ONR-London was effected without reference to a final decision on the report.

## Latin American Office of Aerospace Research

As the January-June 1966 period began, a total of 25 research proposals were being evaluated by various Air Force organizations. By 30 June, an additional 19 research proposals had been received. Of the total 44 proposals, 25 were research proposals for new work and 17 were renewals for existing grants. Of the 25 new proposals, five resulted in grants, six were declined, and 14 were still in the process of evaluation at the end of the period. Of the 17 renewals, ten resulted in grants and of the seven that were still under evaluation, four were being considered favorably.[32]

The new proposals were in the following fields:

| | No. | Accepted | Declined | Being Evaluated |
|---|---|---|---|---|
| Life Sciences | 12 | 3 | 3 | 6 |
| Environmental Sciences | 3 | 0 | 1 | 2 |
| Physical Sciences | 8 | 1 | 2 | 5 |
| Engineering Sciences | 0 | 0 | 0 | 0 |
| Mathematical Sciences | 0 | 0 | 0 | 0 |
| Information Sciences | 2 | 1 | 0 | 1 |
| TOTAL | 25 | 5 | 6 | 14 |

The geographical distribution of the 25 new proposals was: Argentina - 6; Bolivia - 1; Brazil - 7; Chile - 3; Peru - 5; Uruguay - 3.[33]

As of 30 June, there were 35 active Air Force research grants in South America. These represented an annual dollar effort of $366,900, distributed by scientific area as follows:

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[32] "LAOAR Semiannual Historical Report, 1 Jan 1966 - 30 June 1966," 18 Aug 66.

[33] *Ibid.*

| | No. of Grants | Amount |
|---|---|---|
| Life Sciences | 15 | $138,200 |
| Environmental Sciences | 11 | 109,800 |
| Physical Sciences | 5 | 95,000 |
| Engineering Sciences | 3 | 21,100 |
| Information Sciences | 1 | 2,800 |
| TOTAL | 35 | $366,900 |

Geographical distribution was as follows: Argentina - 5; Bolivia - 2; Brazil - 6; Chile - 9; Ecuador - 1; Peru - 7; Uruguay - 2; Venezuela - 1; West Indies - 2.[34]

Dr. Frank Chan, ARL research chemist, arrived in February to begin a six-month research tour at the Laboratorio de Producao Mineral with Prof. Fritz Feigl, who is world renowned for his work on spot tests. In May, a group of OAR physical scientists visited South America and gave a series of lectures and discussions at various educational and research institutions in Brazil, Argentina, Chile, and Peru. Then, in June, an International Conference on the Biota of the Amazon, sponsored indirectly by AFOSR, was held in Belem, Brazil.

## The Frank J. Seiler Research Laboratory

During this period The Frank J. Seiler Research Laboratory (FJSRL) produced 12 significant papers in technical journals and technical reports, the primary output of the Laboratory. All research was in-house and in keeping with OAR policy a level research effort was continued. Faculty and cadet research continued to be supported at a slightly lower level than in previous periods, but plans were initiated which would increase this research during the ensuing periods.[35]

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[34] Ibid.

[35] "Frank J. Seiler Research Laboratory Semiannual Historical Report, 1 January 1966 - 30 June 1966," 1 Sep 66.

Because of the Air Force Academy summer program for cadets, the number of Academy instructors available for temporary duty at OAR laboratories was limited. Only six Academy instructors went to OAR laboratories in the January-June 1966 period.

In the Aerospace Mechanics Division of FJSRL, the shock tube shakedown and calibration was primarily completed by the end of the period. An additional capability was developed for investigating shock wave structure with Raman Spectroscopy and laser stimulation.

## Office of Research Analyses

The Office of Research Analyses (ORA) in-house program for the first half of 1966 included three projects, carried over from previous years, that were completed during the January-June 1966 period, and 19 projects, carried over from previous years, that were still under investigation. Only one project was initiated during this period, and it was also completed in this period. It was Project Light, an evaluation of the feasibility, capability, and desirability of reflector satellites for military uses (Jan-May 1966).

The following projects were carried over from previous years and completed in April, May, and June 1966, respectively:

Hard Basing for Advanced ICBMs[36] (Apr 65)[37]

Colloid-Core Nuclear Propulsion (Jan 65)

Area Defense Against Ballistic Missile Attack—Boost Phase Intercept (Jan 65)

Continuing projects still under investigation include:

Optimization of Trajectories (Oct 57)

Transfer of Momentum in the Solar System (Oct 57)

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[36] Investigated on a consulting services basis.

[37] Initiation date of project shown in parentheses.

Doppler Shift (Oct 62)

Minimum Fuel Trajectories (Oct 60)

Identification of Technological Barriers
and Research Opportunities (Jan 65)

Identification of Research Applications (Jan 65)

Long Range Forecasting Methods (Dec 65)

Identification of Aerospace System Concepts (Dec 65)

Commitment Position Probability for Satellite
Based Systems (Jun 65)

Expected Damage by Nuclear Warheads in
3-Dimensional Space (Oct 65)

Satellite Based BPI of ICBM (Aug 65)

Midcourse Intercept of ICBM (Oct 65)

Manned Orbital Missions (Dec 65)

Limited War Aerospace Missions (Dec 65)

Compensation of Scientists under AFOSR
Grants and Contracts (Oct 65)

Innovation in Liquid Propellant Rocket
Technology (Nov 65)

Area Defense Against Ballistic Missile
Attack—Midcourse Intercept (Jan 65)

Track Facility Development[38] (Oct 65)

Advanced Ballistic Reentry Data Processing
Support[39] (Jul 63)

Besides their in-house and contract efforts, ORA published one special report on Project Light, in April 1966, a paper that had been presented at

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[38]Investigated on a consulting services basis.

[39]Ibid.

the 29th National Meeting of the Operations Research Society of America, in May, three working papers, 13 ORA Internal Technical and Working Memoranda, and one contractor report.

## OAR Human Resources

Authorized and assigned manpower figures for the first half of 1966 remained relatively steady. Compared with the previous six-month period the total authorized strength again dropped slightly, as it did between 30 June 1965 and 31 December 1965. The total assigned strength, already below the authorized strength after a 35-man drop during the 30 June 1965 - 31 December 1965 period, remained almost unchanged. Figures for the beginning and end of the reporting period are as follows:[40]

[40] DCS/Personnel, "Semiannual Historical Report, RCS: AU-D5, 1 Jan 66 - 30 Jun 66," 15 Aug 66.

OAR AUTHORIZED STRENGTH AS OF 1 JAN 66 AND 30 JUN 66

| ORGANIZATION | 1 JAN 66 OFF | AMN | CIV | TOTAL | 30 JUN 66 OFF | AMN | CIV | TOTAL |
|---|---|---|---|---|---|---|---|---|
| Hq OAR | 75 | 41 | 84 | 200 | 74 | 50 | 89 | 213 |
| ARL | 63 | 17 | 248 | 328 | 64 | 19 | 243 | 326 |
| PFOAR | 2 | 3 | 2 | 7 | 4 | 2 | 2 | 8 |
| LOOAR | 5 | 0 | 2 | 7 | 5 | 0 | 2 | 7 |
| VFOAR | 3 | 2 | 1 | 6 | 3 | 2 | 1 | 6 |
| LAOAR | 2 | 0 | 0 | 2 | 2 | 0 | 0 | 2 |
| ORA | 10 | 2 | 29 | 41 | 12 | 2 | 28 | 42 |
| EOAR | 24 | 14 | 23 | 61 | 24 | 14 | 21 | 59 |
| AFOSR | 31 | 2 | 103 | 136 | 30 | 0 | 106 | 136 |
| AFCRL | 82 | 113 | 916 | 1111 | 81 | 115 | 904 | 1100 |
| FJSRL | 17 | 2 | 18 | 37 | 17 | 2 | 18 | 37 |
| TOTAL | 314 | 196 | 1426 | 1936 | 316 | 206 | 1414 | 1936 |

OAR ASSIGNED STRENGTH AS OF 1 JAN 66 AND 30 JUN 66

| ORGANIZATION | 1 JAN 66 OFF | AMN | CIV | TOTAL | 30 JUN 66 OFF | AMN | CIV | TOTAL |
|---|---|---|---|---|---|---|---|---|
| Hq OAR | 66 | 41 | 74 | 181 | 72 | 52 | 87 | 211 |
| ARL | 61 | 17 | 246 | 324 | 55 | 19 | 254 | 328 |
| PFOAR | 2 | 3 | 2 | 7 | 4 | 2 | 2 | 8 |
| LOOAR | 4 | 0 | 2 | 6 | 5 | 0 | 2 | 7 |
| VFOAR | 3 | 2 | 1 | 6 | 4 | 2 | 1 | 7 |
| LAOAR | 2 | 0 | 0 | 2 | 3 | 0 | 0 | 3 |
| ORA | 10 | 2 | 30 | 42 | 8 | 2 | 30 | 40 |
| EOAR | 24 | 13 | 23 | 60 | 27 | 16 | 20 | 63 |
| AFOSR | 25 | 2 | 97 | 124 | 28 | 0 | 105 | 133 |
| AFCRL | 78 | 110 | 937 | 1125 | 73 | 114 | 922 | 1109 |
| FJSRL | 19 | 2 | 15 | 36 | 15 | 2 | 11 | 28 |
| TOTAL | 294 | 192 | 1427 | 1913 | 294 | 209 | 1434 | 1937 |

During this period OAR gained an average of 31 people monthly, while losing 21. Accordingly, the rate for turnover (3.7 percent), accessions (2.2 percent), and separations (1.5 percent) continued without significant change from the July-December 1965 period. In fact, the turnover, accession, and separation rate at OAR has been without significant change since 1 January 1963. There have been, of course, peak gains in June and subsequent losses in September each period, but these were a result of summer employment programs such as the President's Youth Opportunity Campaign. Overall, OAR continued to reflect a healthy employment picture directly comparable to USAF rates and percentages. That was an especially noteworthy record, considering that 67 percent of the OAR workforce were scientists, engineers, and highly-skilled technicians.[41]

OAR personnel officers were still having problems insofar as recruitment of high grade Scientific and Development Engineering (S&DE) personnel. While OAR scientific and professional personnel continued to serve on qualification rating panels to insure quality review and selection of professional candidates, the "competitive process" is inordinately complex, slow, and detrimental to the prompt employment of S&DE personnel. Mandatory Air Force requirements to announce, screen, and approve high grade S&DE positions and personnel GS-15 and above at Command/USAF/DOD/CSC levels continued to be particularly wasteful in OAR because of the highly specialized nature of many individual positions. Despite this, Hq OAR renewed its efforts to obtain an exception to this requirement, which would provide optional rather than mandatory compliance with the directive. There was also a critical problem, at least in the metropolitan Washington area, over the recruitment of stenographers, typists, secretaries, and related clerical personnel.

The President again this year asked public and private enterprises to provide "America's youth" with a chance to work, and requested that one young person per 100 employees be hired. OAR, with a quota of 15 on that basis, employed 66 young people in meaningful jobs. Fifty-six under

under the President's Youth Opportunity Campaign (YOC) at $1.25 per hour and ten from the Office and Science Assistant register at grades GS-2 and 3.

The first half of 1966 served to emphasize the continuing problem of retention. As in the past, the particular category of personnel that were the most needed and upon whom the most effort has been expended were the "Category C" type reserve officers who were performing their initial tour of active duty with the Command after obtaining an advanced degree in science or engineering. Of 18 officers in this category eligible to be released from active duty during this period, 17 elected to return to civilian life. The basic reasons given by these officers for not selecting an Air Force career have not changed. Comparatively low pay rates, slow promotions, and a feeling that their unique status with regard to education and marketable skills has not been recognized by the Air Force, were cited as reasons for leaving the service. The most encouraging development was introduction in Congress this session of legislation to authorize special pay for S&DE officers with advanced degrees. This subject has been a matter of Command interest for several years and would be one concrete step toward finding a partial solution to the officer retention problem.

Thirty-eight officer personnel were requisitioned during this period, with twenty-nine being committed for assignment to this Command. Thirty-four airmen requisitions were submitted, with thirty-four being committed for assignment.

As to officer and airman promotions, the following is a breakdown by grade showing the number of officers and airmen selected for promotion during this period. For officers, in most instances, permanent promotion did not result in a change of insignia as they were already serving in the higher temporary grade.

| Grade | Officers Permanent |
|---|---|
| Lt Colonel | 14 |
| Major | 18 |

| Grade | Airmen |
|---|---|
| Senior Master Sergeant | 2 |
| Master Sergeant | 8 |
| Technical Sergeant | 17 |
| Staff Sergeant | 8 |
| Airman First Class | 5 |

All airmen assigned to the Command were given an assignment availability date (AAD) in conjunction with the newly established four-year stabilized tour imposed by the Military Personnel Center on 10 February 1966. All airmen who arrived in OAR 1 January 1964 and thereafter have had their AAD updated to four years beyond their effective date of change of strength accountability (EDCSA). The airmen who arrived prior to that date, and are within the zone of consideration for overseas selection, will forecast for departure between October 1966 and December 1967. The remaining airmen who are not in the overseas selection zone were extended by Hq OAR for one year. Prior to receipt of this new procedure, airmen were only reported as available for reassignment upon their request and concurrence of their commander, normally after completion of at least four years in OAR.

During the period covered by this report, twenty officers performed active duty tours. Nineteen were 12-day tours and one was a 26-day tour. Additionally, 454 inactive duty training periods were completed. These training periods were for four hours each.

The Air Reserve Forces Personnel Data System (PDS-O) has been under development for the past two years. It closely parallels the active duty PDS-O and we were directed to convert the personnel data contained in the field personnel records of our reservists onto mechanized card formats for transmission to the Air Reserve Personnel Center by 1 August 1966. All manual data was transferred to creation formats for punching, prior to the end of this period. Fourteen card formats for each of OAR's 63 assigned officers were created for the Air Force Reserve Section, Denver, Colorado.

OAR continued to place special emphasis upon the improvement of research capability through an educational development of its workforce, particularly scientists and engineers. During FY 1966, a total of 41,221 manhours were devoted to training, the majority (36,584 hours) through non-government facilities. Approximately 200 people attended graduate study of specialized scientific and technical courses on their own time for 13,718 hours at universities and colleges near their place of work. About 15 employees participated in long-term, full-time graduate study and research programs, using an average of 1,218 hours and $1,866 for tuition, travel, and per diem. In addition, 17 people completed Management I and II courses so that 200 of OAR's 242 supervisors have attended required management courses.

As a result of the establishment of the Central Pool of Spaces and Funds for Long Term Education and Training for Civilian Employees, by which Hq USAF controls spaces and dollars associated with long term development programs, OAR was allocated four additional manpower spaces for the period FY 1966 through FY 1970. These spaces were to be used to cover only those employees who were away from their duty stations on programs of training in excess of 120 days. OAR units that had employees assigned to these "Pool Spaces" could then use the space in any way that would contribute to the achievement of unit objectives during the absence of the trainee. Headquarters USAF has recently requested that commands explore their needs for expansion of the central pool of manpower spaces and funds concept to cover on-base "Input" type programs such as cooperative education, management internship and apprenticeship. OSD has indicated that such a request will now receive full and careful consideration.

On 15 January, after approximately 15 months of negotiations, OAR and the National Academy of Sciences - National Research Council (NAS-NRC) entered into AF Contract No. 49(638)1692 for an associateship program. As indicated in the contract, NAS-NRC were to fully administer the program at an estimated cost of $132,400. Coverage was provided for 10 associates (5 at AFCRL and 5 at ARL). In order to qualify for the program, an associate must hold a Ph.D. and be a U.S. citizen. He must apply to the NAS-NRC, furnishing a laboratory-approved research proposal. His selection,

appointment, and supervision would be by the NAS-NRC. In return, he would receive up to a 1-year appointment, an annual stipend of $10,750, one-way transportation expenses, and would be granted up to one month's paid vacation. The laboratory concerned would furnish the necessary facilities and services and the associate would be subject to the laboratory's security, health and safety rules.

NAS was to provide OAR with semiannual progress reports and final scientific reports. The program got off to a very late start but did attract 12 candidates (7 for AFCRL and 5 for ARL). The NAS appointed 5 (2 at AFCRL and 3 at ARL).

Bolling AFB Civilian Personnel Services, in contrast to effective services provided by other CCPOs, continued to render unsatisfactory service in all areas except Employee and Career Development, and Incentive Awards. This further deterioration was evidenced in widespread management dissatisfaction and failure to keep supervisors informed of cases in progress, answer telephone calls promptly, meet survey schedules, classify and fill positions in a timely manner, provide competent advisory services, etc. The findings of an USAF Inspection Team verified these shortcomings. Plans are now being made to secure civilian personnel services from the CCPO at Andrews AFB on or about 1 August 1966. Request to be serviced by the Pentagon CPO was disapproved by the Secretary of the Air Staff pursuant to AFR 23-7.

The Civil Service Commission (CSC) initiated a special review of manpower management at selected Air Force R&D organizations during this period as a result of complaints received while conducting a nationwide evaluation of Air Force Personnel Management. The object of the review was to evaluate Air Force R&D manpower management practices, especially the effect of controls over spaces, grades, and salaries in accomplishing the RDT&E mission. Special attention was also given the extent to which laboratory managers' plans and recommendations are given timely and responsive consideration by their counterparts at higher Air Force levels. The CSC and Air Force representatives visited the Commander, OAR and were briefed by the staff on 8 June. They were scheduled to meet with the Executive Director, AFOSR and to visit AFCRL and ARL in July.

On 9 December 1965, Hq USAF authorized the transfer of administration and servicing responsibility for EOAR's direct hire foreign national employees from Hq USAFE, Wiesbaden, Germany to the American Embassy Belgium in Brussels. They also approved the career appointment and coverage of these employees under the Civil Service Retirement System instead of the Belgian Social Security System. This action was effected 1 February 1966 and concluded 8 months of negotiations between the State Department, the Brussels Embassy, Hq USAF, USAFE, OAR, EOAR and the Belgian Foreign Office. This authority is unique since most direct hire foreign nationals are not given regular Civil Service appointments or coverage under Civil Service Retirement. Long standing problems between EOAR and the Belgian Social Security Administration relating to pay, retirement, and management treatment were the basis for this action and were resolved by the Hq USAF approval of servicing responsibility and Civil Service status for these employees.

Individual awards for this period included a Legion of Merit to Col. Robert E. Fontana, ARL,[42] and 16 Air Force Commendation Medals. Recipients of the Air Force Commendation Medals are as follows:

Col James A. Fava (Hq OAR)
Lt Col Vaughn K. Goodwin (Hq OAR)
Lt Col Ronald M. Howard* (Hq OAR)
Lt Col Bob M. Johnson (ORA)
Lt Col Michael S. Kretow (AFCRL)
Lt Col Augustus F. Williams, Jr. (PFOAR)
Maj James C. Brennan, Jr. (Hq OAR)
Maj Lester J. Schaub (Hq OAR)
First Lt David A. Lee (ARL)
MSgt Robert F. Donaldson* (AFCRL)
MSgt James J. Bragg* (AFCRL)
MSgt Eugene R. Jasmund* (EOAR)

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[42] See section on ARL for details of Col Fontana's award.

*Indicates award of First Oak Leaf Cluster to Air Force Commendation Medal.

MSgt Royce C. Rich (Hq OAR)
TSgt Edward J. Black (FJSRL)
TSgt John E. Bowers (AFCRL)
TSgt Forrest F. McClure (AFCRL)

In addition to the above awards, on 23 June Air Force Chief of Staff, General John P. McConnell, presented the USAF Research and Development Award for outstanding achievements in scientific research during 1965, to two OAR officers. One award went to Major Robert M. Detweiler of ARL, the other went to Captain James T. Neal of AFCRL.[43]

This period also saw several changes in key personnel within the Command. Lt. Colonel Joseph B. Roberts, Jr., Director of Information, received a Southeast Asia assignment and was replaced by Major John Barbato, on 8 April. Colonel James A. Fava, Director of Scientific and Technical Information, was reassigned to the National Aeronautics and Space Administration (NASA) in April. On 9 May, Major Carlton M. Smith (promoted to lieutenant colonel on 25 June) was appointed as the Acting Director. He continued in that capacity for the remainder of the period. Lt. Colonel George Yep, Staff Judge Advocate, transferred to Wheelus AFB in Libya at the end of May and was replaced by Lt. Colonel Andrew S. Horton on 1 June. Lt. Colonel Edwin G. Kellum assumed the duties of the OAR Inspector General on 10 February. Colonel Robert E. Fontana, Commander of ARL, transferred to the Armed Forces Institute of Technology at Wright-Patterson AFB, and was replaced as Commander by ARL's former Deputy Commander, Colonel Paul G. Atkinson, Jr. on 16 June.[44] And, on 1 June, Lt. Colonel John J. Apple of Hq OAR's DCS/Plans & Programs (Directorate of Test Support) took over as Commander of OAR's Patrick Field Office upon the retirement of former Commander, Lt. Colonel Augustus F. Williams, Jr.

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[43] See sections on ARL and AFCRL for particulars concerning these awards.

[44] See section on ARL for full particulars.

## KEY PERSONNEL

January - June 1966

**HEADQUARTERS OAR**

| | |
|---|---|
| Commander | Brig Gen Ernest A. Pinson |
| Deputy Commander | Col James C. Dieffenderfer |
| Special Assistant to the Commander | Lt Col John G. Garvin |
| Chief of Staff | Col Jack W. Streeton |
| Deputy Chief of Staff/Plans & Programs | Col Thomas M. Love |
| Deputy Chief of Staff/Financial Programs | Lt Col Ira H. S. McMann |
| Deputy Chief of Staff/Materiel | Col Robert B. Laurents |
| Deputy Chief of Staff/Personnel | Col Burl R. Williams |
| Director of Information | Lt Col Joseph B. Roberts, Jr. (promoted 20 Mar 66) ( - 7 Apr 66)<br>Maj John Barbato ( 8 Apr 66 - ) |
| Director of Manpower & Organization | Mr. Harry M. Dyson |
| Director of Administrative Services | Maj Paul H. Crandall |
| Director of Scientific & Technical Information | Col James A. Fava ( - 22 Apr 66)<br>Lt Col Carlton M. Smith (Actg) (promoted 25 Jun 66) ( 9 May 66 - ) |
| Inspector General | Lt Col Edwin G. Kellum |
| Staff Judge Advocate | Lt Col George Yep ( - 31 May 66)<br>Lt Col Andrew S. Horton ( 1 Jun 66 - ) |

KEY PERSONNEL (cont.)

January - June 1966

**HEADS OF SUBORDINATE ORGANIZATIONS**

| | |
|---|---|
| Air Force Cambridge Research Laboratories | Col Robert F. Long<br>Commander |
| Air Force Office of Scientific Research | Dr. William J. Price<br>Executive Director |
| European Office of Aerospace Research | Col Jack L. Deets<br>Commander |
| Aerospace Research Laboratories | Col Robert E. Fontana<br>Commander ( - 15 Jun 66)<br>Col Paul G. Atkinson, Jr.<br>Commander (16 Jun 66 - ) |
| Patrick Field Office<br>DET No. 4 | Lt Col Augustus F. Williams, Jr.<br>Commander ( - 31 May 66)<br>Lt Col John J. Apple<br>Commander ( 1 Jun 66 - ) |
| The Frank J. Seiler Research Laboratory | Col Gage H. Crocker<br>Commander |
| Los Angeles Office<br>DET No. 6 | Lt Col John C. Hill, Jr.<br>Commander |
| Latin American Office<br>DET No. 7 | Lt Col Charles J. Lyness, Jr.<br>Chief |
| Office of Research Analyses<br>DET No. 8 | Lt Col William E. Wright<br>Commander |
| Vandenberg Field Office<br>DET No. 9 | Lt Col Levin W. Parker, Jr.<br>Commander |

## CIVILIAN GRADE CEILING & SALARY OBJECTIVE

## 30 JUNE 1966

| ORGANIZATION | GS-14 | GS-15 | GS-16 | Average Salary |
|---|---|---|---|---|
| HQ OAR | 6 | | | $ 8,408 |
| LOOAR | | | | 5,700 |
| ORA | 8 | 4 | 1 | 12,183 |
| PFOAR | 1 | | | 12,100 |
| VFOAR | | | | 5,580 |
| AFOSR | 7 | 19 | 2 | 10,344 |
| AFCRL | 139 | 62 | 17 | 11,673 |
| ARL | 30 | 17 | 8 | 11,420 |
| EOAR | | | | 6,400 |
| FJSRL | | | | 6,349 |
| TOTAL | 191 | 102 | 28 | $11,254 |

# GENERAL SCHEDULE AVERAGE GRADES

## 30 JUNE 1966

| ORGANIZATION | 30 JUNE 66 | 31 DEC 64 |
|---|---|---|
| HQ OAR* | 7.50* | 8.18* |
| AFOSR | 8.63 | 9.80 |
| AFCRL | 11.07 | 11.04 |
| ARL | 10.71 | 10.77 |
| EOAR | 5.83 | 7.00 |
| FJSRL | 6.00 | 6.00 |
| ORA | 10.46 | 11.12 |
| COMMAND AVERAGE | 10.52 | 10.67 |

*Includes all detachments except ORA.

## CIVILIAN POPULATION BY PAY CATEGORY

## 30 JUNE 1966

| ORGANIZATION | TOTAL | GS | PL313 | CONSULT | WB | YOC | FN |
|---|---|---|---|---|---|---|---|
| HQ OAR | 98 | 87 | | 10 | | 1 | |
| LOOAR | 2 | 2 | | | | | |
| ORA | 36 | 28 | 2 | 4 | | 2 | |
| PFOAR | 2 | 2 | | | | | |
| VFOAR | 1 | 1 | | | | | |
| AFOSR | 105 | 97 | 8 | | | | |
| AFCRL | 948 | 830 | 9 | | 62 | 47 | |
| Balloon Activity | 12 | 9 | | | 1 | 2 | |
| Sac Peak Obc | 11 | 9 | 1 | | 1 | | |
| Hamilton AFB | 1 | 1 | | | | | |
| ARL | 260 | 216 | 6 | 2 | 32 | 4 | |
| EOAR | 20 | 6 | | | | | 14 |
| FJSRL | 11 | 10 | | | 1 | | |
| TOTAL | 1507 | 1298 | 26 | 16 | 97 | 56 | 14 |
| PERCENT | | 86% | 2% | 1% | 6% | 4% | 1% |

## EDUCATIONAL LEVELS OF
## CIVILIAN PROFESSIONAL SCIENTIFIC & DEVELOPMENT ENGINEERING PERSONNEL

### 30 JUNE 1966

| ORGANIZATION | PhD | MASTERS | BACHELOR | NO DEGREE | TOTAL |
|---|---|---|---|---|---|
| HQ OAR | | 2 | 2 | | 4 |
| AFCRL | 130 | 164 | 179 | 56 | 529 |
| AFOSR | 23 | 7 | 1 | | 31 |
| ARL | 55 | 42 | 29 | 2 | 128 |
| FJSRL | 1 | | 2 | | 3 |
| EOAR | -- | -- | -- | -- | -- |
| ORA | 7 | 7 | 2 | | 16 |
| TOTAL | 216 | 222 | 215 | 58 | 711 |
| PERCENT | 31% | 31% | 30% | 8% | |

## TYPES OF CIVILIAN PERSONNEL

## 30 JUNE 1966

| | | |
|---|---|---|
| Scientific and Engineering | 711 | (50%) |
| Technical Support | 245 | (17%) |
| Other | 478 | (33%) |
| TOTAL | 1,434 | |

## CIVILIAN INCENTIVE AWARDS

## FY 1966

| ITEM | NUMBER | PERCENT | AMOUNT |
|---|---|---|---|
| 1. Average Number Employees Assigned | 1380 | | |
| 2. Suggestions/Inventions Received | 236 | 17.10 | |
| 3. Suggestions/Inventions Adopted/Paid | 59 | 25.00 | $4,660 |
| 4. Sustained Superior Performance Awards | 49 | 3.55 | $8,800 |
| 5. Quality Salary Increases | 38 | 2.75 | |
| 6. Outstanding Performance Ratings | 57 | 4.13 | |
| 7. Special Act/Services | 13 | .94 | $2,805 |
| 8. Honorary Awards (Exceptional) | 1 | | |
| (Outstanding Unit Award) | 87 | 3.55 | |

Combined SSP and QSI approvals - 6.30%

Excluded are non-federal awards, commendations, and letters of appreciation.

## Financial Resources - FY 1966

In Fiscal Year 1966 the funds made available to OAR totalled $151 million. While it represented yet another annual increase in OAR funds (FY 1962 - $108 million; FY 1963 - $114.4 million; FY 1964 - $116.7 million; FY 1965 - $123.5 million), the total figure still represented less than one-half of one percent of the total DOD FY 1966 obligation.

The funds made available to OAR were divided into the following major categories. The Defense Research Sciences are further subdivided to show the fund distribution in 13 scientific areas in which OAR does research.

| | Millions |
|---|---|
| Defense Research Sciences | $ 84.5 |
| Environment | 10.5 |
| Aerospace Research Support Program | 11.7 |
| Lab Director's Funds | 2.5 |
| Command Management Funds | 2.7 |
| RAND | 15.0 |
| ANSER | 1.3 |
| Reimbursable Funds | 6.8 |
| TOTAL | $135.0 |

| Defense Research Sciences: | Percent |
|---|---|
| General Physics | 21 |
| Atmospheric Sciences | 14 |
| Mechanics | 11 |
| Electronics | 10 |
| Energy Conversion | 9 |
| Astronomy and Astrophysics | 7 |
| Mathematical Sciences | 7 |
| Chemistry | 6 |
| Nuclear Physics | 4 |
| Behavioral and Social Sciences | 3 |
| Biological and Medical Sciences | 3 |
| Materials Research | 3 |
| Terrestrial Sciences | 2 |

In addition, the OAR capital accounts reflect:

| | |
|---|---|
| Equipment | $35.8 million |
| Facilities | $30.0 million |

Also, in FY 1966, our Air Force Cambridge Research Laboratories received approximately $12 million from Air Force Systems Command activities for efforts on the latter's behalf; while OAR received $16 million for efforts on behalf of the Advanced Research Projects Agency.

The Defense Research Sciences constitute the complete research program for the U.S. Air Force, while the Environment program covers Exploratory Development efforts in the Environmental Sciences only. Aerospace Research Support funds provide the hardware and payload buildup for aerospace experiments conducted for both the Office of Aerospace Research and the Air Force Systems Command. The Laboratory Director's funds provide a source of dollars, largely unrestricted in application, to the individual director to initiate new work in his organization's area of interest. Command Management funds cover the operating expenses of the headquarters and various field offices.

Distribution of the OAR FY 1966 basic research contracts and grants program by type of performer was as follows:

| | Million | Percent |
|---|---|---|
| Educational Institutions | $40.7 | 69 |
| Industry | 13.0 | 22 |
| Non-profit Organizations | 3.4 | 6 |
| Other | 1.5 | 3 |
| TOTAL | $58.6 | |

## Funding Research in Foreign Countries

Overseas research sponsored by the U.S. Air Force successfully offset adverse effects upon the Nation's Balance of Payments. The dollar outflow for research was substantially reduced during the last three fiscal years. This was accomplished without sacrificing the quality or number of essential overseas research programs.

To minimize the Balance of Payment impact of sponsored overseas research, OAR launched a four-pronged attack to allow unique foreign science to contribute to ongoing Air Force programs without weakening the dollar.

OAR expanded its cost-sharing arrangements with foreign scientists and educational institutions. For example, in FY 1965, foreign scientists contributed $1.28 for each Air Force dollar. The Air Force thereby obtained a $8.4 million research program for a direct investment of approximately $3.7 million.

By encouraging foreign scientists to purchase U.S. equipment and supplies and transporting them on U.S. flag carriers, OAR's efforts produce nearly $250,000 yearly in export sales.

OAR uses $600,000 annually of U.S.-owned foreign excess currency to pay contracts and grants. These currencies are excess to U.S. needs in certain countries and are purchased by U.S. Disbursing Activities with Air Force appropriations.

Finally, OAR, with the cooperation of the Office of Barter and Stockpiling, Foreign Agriculture Service, and the U.S. Department of Agriculture, obtained a $5.05 million allotment in surplus commodities for barter purposes. The sale proceeds of these commodities would be used to pay European contracts and grants awarded in FY 1966 and FY 1967 and the Commodity Credit Corporation was reimbursed, accordingly, with appropriated dollars.

## The OAR Management and Scientific Information System (MASIS)

The effectiveness of management policies within the Office of Aerospace Research, is a prime consideration at all levels where resources

are allocated and managed. Because the prime product of the OAR is research, the effectiveness of management policies is related directly to the work being done by the individual scientists on his particular research effort. Several thousand research efforts are being actively conducted at any one time, either at laboratories operated by the Command or under funding support through its contract and grant program. By mechanizing data available, describing research at the individual research effort level, and providing for retrieval of that information, according to the terms used by the individual managers in evaluating their efforts, the OAR has acquired a tool whereby data can be transformed into useful information by the people of OAR. For example, the manager of a large research effort is able to address himself to the question "What research is being done in my area irrespective of fund source or budget program classification?" Managers of research program areas are able to examine recapitulations of the aggregate picture of work units supported by their programs. Even the managers of procurement activities are able to learn the status of individual contracting actions, which show them an overall picture of how effective their procurement is in negotiating contracts, executing contractual instruments, and when the research is finished, obtaining final reports resulting from the research. OAR recognizes that the transition from data to information is not obtained without study and analyses on the part of people. OAR's objective is to make the data going into this process accurate and available in a timely, meaningful fashion. The OAR Management and Scientific Information System is an evolving data processing system, with the objective of obtaining greater and greater usefulness from data processing techniques to support and enhance research management effectiveness within our Command.

The computer system described in the preceding paragraph is coupled with OAR's standard punched card accounting system to provide a complete data base for comprehensive management review and analysis of financial operations of the Command.

In allocating resources, OAR, like any other business organization, whether it be governmental or industrial, accumulate and review historical data and temper it with the forecasts or the Command's laboratories. The

primary tool for establishing bulk allocations to OAR laboratories is the cost of research index established for OAR by the RAND Corporation in a special study of a substantial sample of contract and grant proposal costs in our data store.

In the process of planning their expenditures, under the lump sum of money that OAR has allocated, it asks its laboratories to arrange their plans into categories such as operation and maintenance, technical services, complementary contractual research, etc. OAR, in turn, reviews progress and status by looking at the character of laboratory operations through these relatively large analysis groups (categories) rather than attempting to review a mass of detailed accounting data. The required management accounting groupings are obtained by the application of a simple internal conversion to the standard accounting detail.

## GLOSSARY

| | |
|---|---|
| AAC | Alaskan Air Command |
| AAD | Assignment Availability Data |
| ADC | Air Defense Command |
| AFAL | Air Force Avionics Laboratory |
| AFATL | Air Force Armament Laboratory |
| AFCRL | Air Force Cambridge Research Laboratories |
| AFIT | Air Force Institute of Technology |
| AFOMO | Air Force Office of Manpower and Organization |
| AFOSR | Air Force Office of Scientific Research |
| AFRPL | Air Force Rocket Propulsion Laboratory |
| AFRST | Air Force Director of Science and Technology |
| AFSC | Air Force Systems Command |
| AIAA | American Institute of Aeronautics and Astronautics |
| AMC | Air Materiel Command |
| APT | Automatic Picture Taking |
| ARDC | Air Research and Development Command |
| ARL | Aerospace Research Laboratories |
| ARPA | Advanced Research Projects Agency |
| ARSP | Aerospace Research Support Program |
| ASD | Aeronautical Systems Division |
| AWS | Air Weather Service |
| BOD | Beneficial Occupancy Date |

| | |
|---|---|
| CRR | Churchill Research Range |
| CSC | Civil Service Commission |
| DCS | Deputy Chief of Staff |
| DDR&E | Director of Defense Research and Engineering |
| DOD | Department of Defense |
| EDCSA | Effective Date of Change of Strength Accountability |
| EOAR | European Office of Aerospace Research |
| ESD | Electronic Systems Division |
| ETL | Electronic Technology Laboratory |
| FAA | Federal Aviation Agency |
| FJSRL | (The) Frank J. Seiler Research Laboratory |
| FTD | Foreign Technology Division |
| GSA | General Services Administration |
| LAOAR | Latin American Office of Aerospace Research |
| LDF | Laboratory Director's Fund |
| LOOAR | Los Angeles Office of Aerospace Research |
| MASIS | Management and Scientific Information System |
| NAS | National Academy of Sciences |
| NASA | National Aeronautics and Space Administration |
| NRC | National Research Council |
| NSBEO | National Sonic Boom Evaluation Office |
| OAR | Office of Aerospace Research |
| OASD | Office of the Assistant Secretary of Defense |
| OGO | Orbiting Geophysical Observatory |

| | |
|---|---|
| ONR | Office of Naval Research |
| ORA | Office of Research Analyses |
| OSD | Office of the Secretary of Defense |
| OV | Orbiting Vehicle |
| PFOAR | Patrick Field Office of Aerospace Research |
| RCA | Radio Corporation of America |
| R&D | Research and Development |
| RDT&E | Research Development Test and Evaluation |
| SAB | Scientific Advisory Board |
| SAC | Strategic Air Command |
| SAG | Scientific Advisory Group |
| S&DE | Scientific and Development Engineering |
| SDI | Selective Dissemination of Information |
| SEA | Southeast Asia |
| SEAORS | Southeast Asia Operational Requirements |
| SESP | Space Experiments Support Program |
| SSD | Space Systems Division |
| STINFO | Scientific and Technical Information |
| UAC | United Aircraft Corporation |
| USAFE | United States Air Forces in Europe |
| VFOAR | Vandenberg Field Office of Aerospace Research |
| YOC | Youth Opportunity Campaign |

## INDEX